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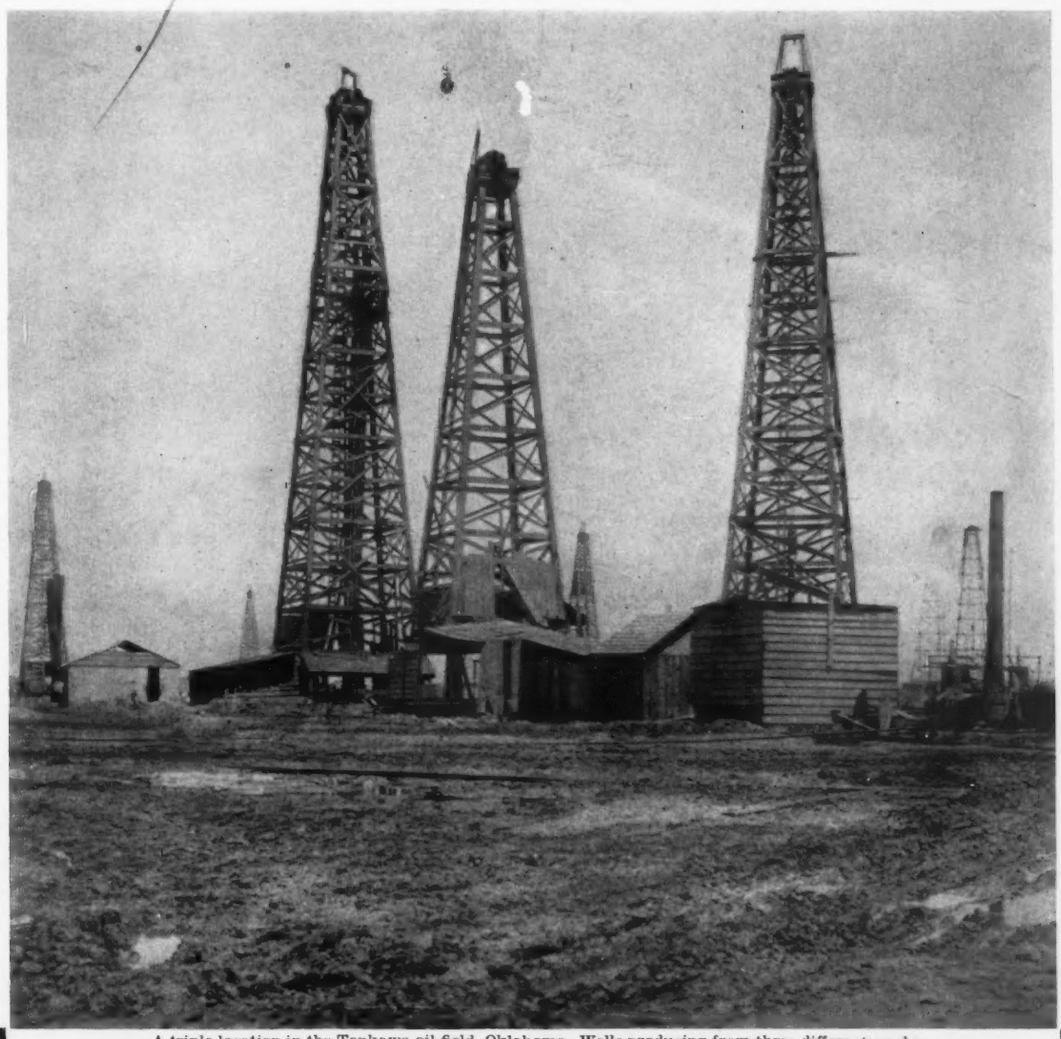

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August 11, 1923

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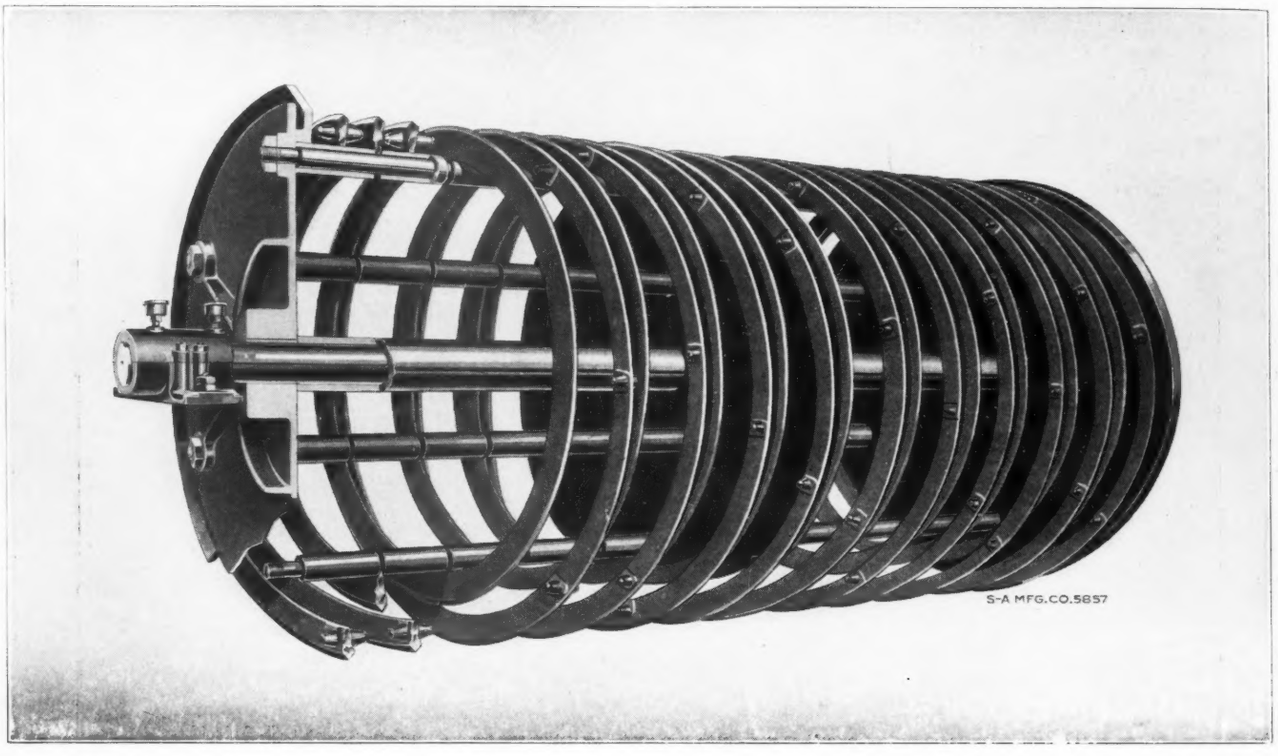

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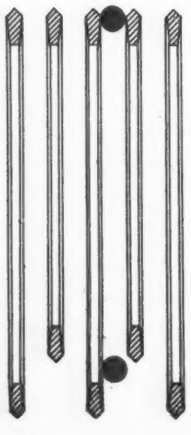

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ENGINEERING & MINING
JOURNAL-PRESS
JOSIAH EDWARD SPURR, Editor

Volume 116 | New York, August 11, 1923 | *Number* 6

WARREN G. HARDING

THE loss of a President cannot properly be estimated at the time. It is only with the lapse of years that those who figure in the world's history are seen in their true proportions. Much was accomplished by Harding in his administration. Outstanding achievements were the executive budget system, the reduction in taxation and the conference on armament limitation which resulted in the Four Power treaty between Great Britain, France, Japan and the United States. Of this Elihu Root said that he doubted if any formal treaty ever accomplished so much by doing so little. As Chief Executive the late President found his way beset with unusual difficulties, which serve the more to accentuate what he accomplished. As a man he was likable and charmed those who had the privilege to know him intimately. He will be affectionately remembered and history will accord him a place prominent among those who have served the country well in its highest office.

A Future Mining Industry

THE United States has always depended on importation for its supply of two of the three chief fertilizer minerals—nitrates and potash. Of the third—phosphates—it has an abundant native supply. During the war its supply of potash salt from Germany—the world's natural storehouse of that mineral—was cut off, and this the German scientists confidently counted on as eventually operating to starve the United States and the world into submission. Supplies of imported nitrates from Chile—the world's natural reservoir of that mineral—continued, however; and the production of nitrates and potash within the United States increased considerably under the stimulus of war prices, though the domestic supplies never by far reached the permanent need. With post-war conditions, and the demands of the farmers for cheap potash, the young domestic industries failed to get the tariff protection necessary to insure further growth, or even continuation; so that for supplies of both potash and nitrates the United States is back to its pre-war basis of importation of the natural salts from Europe and Chile respectively. There is a compelling economic reason for this, of course; from the natural water-soluble salts the necessary element can be produced far more cheaply than through more complicated chemical processes of extraction. There is plenty of potash and nitrates to be had everywhere, but the question is the cost of production. Nowhere in the United States have we found natural nitrate beds of importance like those of Chile or natural potash beds of importance like those of Germany and Alsace.

But it is now becoming increasingly possible that there do exist in the State of Texas potash beds geologically and chemically similar to those of Europe, and the U. S. Geological Survey is now willing to go on record as prognosticating a probable ultimate important production from this source. When this occurs, the initial discovery must be credited to science, for the presence of potash in the Texas beds was first announced by Dr. J. A. Udden, of the University of Texas, in 1914.

An excellent summary of the situation is given by Dr. George R. Mansfield, of the U. S. Geological Survey, in *Industrial and Engineering Chemistry* for May. The potash-bearing beds of Texas are of the same geological age as those in the famous Stassfurt district, in Germany; the Texas beds contain much common salt, and by all analogy and probability it was to be expected that they would also contain commercial potash beds. A well drilled in 1915-1916 by the U. S. Geological Survey had no success, however, in finding potash. But since then a number of wells drilled for oil have demonstrated that potash actually exists over a wide area; and Dr. Mansfield observes "Some far-sighted company with a view to future rather than immediate returns, or even the government itself, should make a systematic campaign of investigation. It is believed that the evidence already obtained points strongly to the probability of deposits of commercial value and would justify the needed expenditure.

"No one should enter the Texas potash field with the idea of securing quick and large returns. To the cost of preliminary exploration must be added the cost of sinking shafts to depths perhaps as great as 2,000 ft. and the costs of construction and labor for operating deep mines. The present market for potash is largely in the eastern and southeastern seaboard states accessible to cheaply transported foreign potash, whereas from Texas transportation charges to these states are higher. On the other hand, there is a growing need for fertilizers, most of which contain some potash, in the Central and Great Plains States, which are less accessible to foreign potash. These would be more easily reached by the Texas product. Sooner or later the demand in these states will be sufficient to support a potash industry and Texas potash will come into its own. It is greatly to be hoped that this day will be speeded, for the economics of the hour demand a rehabilitation of our rapidly depleting soils and an earnest effort to increase the amount of foodstuffs for export."

We heartily second Dr. Mansfield's recommendations, whether to private capital or to the government. The Survey is much to be congratulated on the spirit it shows in estimating the field favorably, in spite of the failure of its own drill hole. One swallow does not make a summer; the Congressional appropriation for Dr. Langley's first airplane only resulted in failure; another appropriation would have resulted in success. A further government appropriation for determining the commercial extent of potash in Texas would be justified; but far better would be government countenance and support of private capital; this has been shown to work out best, in spite of the visions of the parlor reformers.

Will It Pay to Develop Arsenic Deposits?

IN THE LAST FEW MONTHS, when the price of white arsenic has been from 10 to 15c. per lb., numerous inquiries have come to the *Journal-Press* as to how long high prices might be expected to last, and as to the type of equipment necessary for the recovery of arsenic from ores that are rich in that element. Many people who have control or can secure control of suitable deposits are wondering whether it will pay to develop them.

The demand for arsenic has been caused by the large amount of arsenical insecticides needed to combat the boll weevil in the cotton fields of the South. There is nothing to indicate that the boll weevil will not continue to be as much of a pest as it has been since it arrived from Mexico. It apparently likes its new home, except when it is obliged to eat poison, and there seems little likelihood that it can be poisoned out of existence any more speedily than have potato bugs, cabbage worms, and such nuisances. In fact, it is probable that its numbers will rather increase and that other marauding insects requiring poison to combat them will also multiply. Some poison will almost certainly be necessary, and unless arsenic sells for considerably higher prices than at present, its demand for insecticide manufacture promises to continue large and to increase. Other substances may, of course, displace it, but there seems no likelihood of this happening in the near future.

However, current prices have stimulated production greatly, and even though the demand is large, the price can hardly stay at present levels for any great length of time. There is no lack of high-arsenic ores, and no elaborate plant is required to recover the oxide. It does not seem likely that the price will revert to the former figure of 3 to 4c., for in those days the demand was exceedingly small compared to the amount wasted at the various smelters in the country, so that the price level naturally settled at about the cost of production. Now this cost of production is higher, and with the improved demand an average price of at least 5c. per lb. over, say, the next five years would seem to be a conservative estimate. It is doubtful if it would be advisable to go to any great expense in the development of a mine solely for its arsenic content, or in the equipment of a new plant for arsenic recovery, unless a good profit could be expected at this price, for the potential arsenic output of present smelters is probably at least 20,000 tons a year, and the high prices have already resulted in the installation of equipment to recover much of the arsenic heretofore wasted.

The equipment necessary for the production of white arsenic is not complicated, arsenic being easily roasted to the oxide, which material is then cooled and condensed. The large smelters recover arsenic from their flue gases by baghouses or by the Cottrell process. The purity of such material is not high, however, so it is usually further refined in a small reverberatory. Roasting furnaces of the McDougall type are also used. The methods used are mentioned in the chapter on arsenic in the 1920 issue of "Mineral Resources," published by the U. S. Geological Survey. Recently some furnaces have been built solely for the treatment of high-arsenic ores; such, for example, is that of the Jardine Mining Co., described in this journal on May 12, on page 859.

The U. S. Department of Agriculture and the U. S. Bureau of Mines co-operated in an investigation of the arsenic situation last winter, and the Canadian Department of Mines is studying the subject this summer.

Getting Ready for the Reno Conference

IT IS REPORTED that Colorado is already planning to send a large delegation of mining men to the conference of silver producers to be held at Reno, Nev., on Sept. 4—not Aug. 15, as we inadvertently stated a few weeks ago. Doubtless other states will send representatives when the time arrives to discuss the serious matters that will be presented at the meeting. Senator Pittman is now in the West making preparations for the hearings of the Commission of Gold and Silver Inquiry and the conference. A strong probability exists that some constructive action or recommendation may result from bringing together under one roof the collective opinion of so many factors in the silver-mining industry of the Americas.

One danger confronts the conference—the possibility that radical, instead of sane, action may be advised. Too often silver miners have advocated a way out of their difficulties that in the end has cost them more than it was worth. The gravity of any recommendations which the conference may urge producers to take can hardly be overemphasized. Unless a sound solution to the troubles of the industry is found, the silver miners may do themselves more harm than good. They should not forget that they are dealing with a world commodity, one that fills an important function in the life of hundreds of millions of Asiatics and Europeans. They should remember that if they do anything inimical to the best interests of these people they are likely to provoke retaliatory measures and swift retribution.

The history of trading in many commodities shows that it is next to impossible to control prices for any appreciable length of time by the manipulation of supplies or stocks alone. Particularly is this true of silver, which is an especially speculative commodity. Besides dealing with the marketing of an important metal, the conference at the same time must consider the relevant questions of exchange and finance, two elements that complicate the problem.

It is not an easy task which the silver conference has set before it.

The Passing of Newhouse

TIME EFFACES MONUMENTS — even the Pyramids will disappear, though they are resisting nobly, unless perchance guniting or some thing similar be employed to save them. Occasionally man cheats time of its task and accomplishes the removal with more dispatch. Years ago in southern Utah a man now prominent built himself a monument on the desert. An interesting monument it was, for it consisted of a company town of attractive houses which bore the great man's name. A copper mine—the Cactus—near by, was the reason for its existence. For a brief space the Cactus prospered—or seemed to—but soon its heyday passed, for high-grade, like youth, does not last forever. Thus fair Newhouse, nestling at the foot of Quartzite, among the lizards, horned toads, and cacti, fell on evil days. New owners of the Cactus made a noble effort, which the ore could not reward. Milling is apt to be unprofitable when the tails are little poorer than the heads. Eventually it came about that the tailings dump was the most attractive of the company's holdings from a financial point of view. These tailings were treated by leasers at a profit by flotation, and it was the same dump that recently figured in a decision of the United States Supreme

Court, in which the court stated, in a tax suit, that the tailings constituted a unit of property entirely apart from the mine from which they came.

Now that the dump, having been worked, is worthless, little remains for the owners but to pull up stakes and go. This they have literally done, and, one by one, the little stucco cottages that constituted the camp have been moved to Milford, the nearest town, 25 miles away. All that is left is the local store, whose keeper is apparently doomed to stay until he has eaten up his stock. Thus the West is spared another abandoned camp, with vacant houses whose windows stare into the past. Thus also crumbles the great man's monument, though little does he care, for he has others. Once more the land, almost desert but for a time made habitable by water brought from springs nine miles away, reverts to the coyotes and the passing sheep herder. Little but memories remain of Newhouse, but what memories!

Encouragement for Cripple Creek

THE HISTORY of most mining camps shows that they literally spring up overnight and have all the attributes of mushrooms—temporary virility, conspicuous positions, and rapid decay. If early prospecting gives evidence of large deposits or mines with a probable long life, the camp may take on a more substantial appearance. Brick or stone houses are then erected, and a mining city emerges from the site of the older settlement, giving it an air of permanence which may obscure the fact that, like its mushroom predecessor, it also has but a limited existence. This thought is vividly driven home when the spectacle of a mining camp with houses and stores boarded up, idle mine plants—generally in a dilapidated condition—and deserted streets is seen. Some of Colorado's mining districts have a quietness that fits in with this description. Cripple Creek is one of them. It is moderately active—not nearly so much as in its prime—and turns out nowadays only a fraction of its former production. Being a gold camp, it has been seriously affected by the slump in the purchasing power of gold and by the exhaustion of some of its orebodies. It is difficult to believe, however, when one walks over the ground, and studied the history of this great district, with its long life and millions in gold produced, that the camp has yielded its utmost. The thought keeps recurring that surely veins still remain to be discovered and that it only requires courage, capital, and intelligent prospecting to uncover new orebodies. Doubtless such reasoning has animated W. Spencer Hutchinson and his principals in recently taking over a large tract of land in the Cripple Creek region with the intention of prospecting and developing it. They deserve to be rewarded for their initiative in taking hold in a district that has shown signs of being on the down grade. Their action will prove a decided stimulus to mining in the camp. It is not at all improbable that they may be as fortunate or more so than the two largest gold-mining companies in the area, the Portland Gold Mining Co. and the Cresson Consolidated Gold Mining Co., in their activities. Both of these famous producers profited by their foresight in developing their properties at depth and struck rich oreshoots, or their extensions, which will help them materially in continuing their corporate existence. The Portland had to go so far as to increase greatly the funded indebtedness of the company to obtain the money necessary to perfect its plans. However, as a result of its efforts, the company has now a much brighter outlook than it had a few months ago and has demonstrated the fact that Cripple Creek contains ore for those who will keep up the search for it.

The Sulphate Process

IN THE SOUTHWESTERN part of Colorado, at one of the smelters of the A. S. & R., a metallurgical test is being made on complex lead-zinc ores and is being keenly watched by miners throughout the state and elsewhere. This is the sulphate process. Interest in the work has often reached so high a pitch that enthusiastic comments have been made by untechnical and other newspaper writers which have hardly been in accord with the facts. They have caused considerable annoyance and embarrassment to the inventors and operators of this test, and for this reason they have been anxious to avoid further publicity until such time as their experiments are concluded. Then they intend to publish in detail the results of their work—a commendable action. In the meantime it is well to be considerate of the difficulties involved in the process and the troubles that usually beset any original work such as establishing a new metallurgical method. In most new processes, especially in the initial work, troubles arise that are entirely unforeseen by the inventors. The men who have started the new sulphate plant have been also similarly hindered.

It may be well to stress the wish of the originators of the process to use the designation "Sulphate" instead of "Coolbaugh." It has been, and is, widely known by the name of one of its inventors, but the change suggested is a good one and should be easily made. It falls in line with other metallurgical terminology which rightly prefers to label a process by a feature of its action rather than baptize it with some proper noun. Thus the cyanide process is not known as the McArthur and Forrest process; the flotation process has not been dubbed by the name or names of early workers with it. Confusion is avoided in the profession by using the simpler phraseology. The name cyanide of itself suggests the principle involved. So does the word sulphate, for the secret of this new method is the conversion of the complex sulphides in Colorado ores to sulphates by careful roasting, then the leaching by water of the sulphates and the separation of the zinc sulphate from the lead and copper, the zinc sulphate to be sold as such or treated for its zinc content.

The Compliment of Borrowing

IT IS A TRIBUTE when extracts from our columns are copied into other journals, with the customary credit; and although our journal is copyrighted, we always grant our approval when it is requested. Possibly more of a compliment is it when our material is republished without crediting the source, for that signifies that the borrowing journal thinks the views expressed so sound that it is willing to assume responsibility for them. When, as happens now and then, one of our editorials is later found among the editorials of another journal without the source being referred to, the implied tribute becomes very subtle indeed. Such is the case with the recent leading editorial of the *Daily Silver Belt* of Arizona, on "The Wealthy Osage," which editorial first appeared in our issue of June 16, 1923.

DISCUSSION

"Engineering and Mining Journal-Press" is not responsible for statements or opinions published under "Discussion." In many cases the views expressed are diametrically opposed to editorial policy and belief.

The Fundamentals of Money

THE EDITOR:

Sir—In view of the attention that is now being given to the production of gold and silver, the following observations and comments may interest the readers of the *Engineering and Mining Journal-Press*. It is regrettable that, as a rule, writers on the general subject of money do not seem to understand the basic principle on which it is founded. Briefly, the exchange of standard money for commodities, or services, is simply the exchange of one commodity for another, or the exchange of the standard commodity for services.

In ancient times, in some countries, the basic principle of money was thoroughly understood by the masses; but, in recent times, the introduction of substitutes for money and the fact that such substitutes are, improperly, called money has so befogged the average intellect that anyone who really does understand the subject now is a rarity.

Its basic principle is exceedingly simple; in fact it is just plain barter; and, when so considered, its study reveals that it is an exact science. But its various ramifications cannot be followed out in this article; it would require far too much space, so let us touch upon a few of the high spots only.

Standard money is the commodity that has been chosen as the measure in terms of which the exchange values of all other commodities, and services, are expressed. A metal, of one kind or another, has been found by experience to be the best suited for money purposes. History tells us that, in earlier times, the money-metal was weighed out for each individual transaction or exchange of goods that involved the use of money; and that such sale of money-metal for goods, or *vice versa*, caused more or less dispute or wrangling, both over the purity or fineness of the metal so offered for sale and the accuracy of the scales used in weighing it. (Just imagine the jolly time we would have nowadays if we had to dispute with the ticket chopper about the accuracy of his scales whenever we offered him a small chunk of unstamped money-metal for our fare in our haste to get to our office!)

It was to avoid dispute of this nature that, in the old days, coins were devised or invented—about 900 B. C. As a result of such invention, the sovereign of a country caused a device to be stamped upon a chunk of money-metal, as an assay certificate, certifying to the weight and purity of each particular piece of metal so marked.

Various kinds of notes, in the form of what are, also, called "paper bills" and which are, virtually, promises to pay money, are universally called "money," because the people at large do not really understand the basic principle of money. To such people, money is something that they can carry in their pockets to buy things with, and as long as it is "good" they have no worry. When it is considered scientifically, however, it does not permit of ambiguity in words or phrases used in discussing it. A single word cannot be used, intelligently, to mean, at the same time, both a particular weight of a certain metal and a promise to pay such a weight of such a metal. Of course, a promise-to-pay money may be "good," in the sense that it will be universally accepted by the people at its face value in payment for commodities and services; but, from a technical or scientific standpoint, the word used to designate a particular weight of a certain metal must not be used to mean, also, a promise to pay such weight of such metal, because they are two entirely different things and are based upon entirely different principles, and they must be so differentiated in all scientific discussions in which they are involved. One *is* a *fact*, and the other may or may not become a fact. The paper currencies of Germany and Russia are good illustrations of the latter so-called paper "money."

Recently, the daily press has told of a find of ancient Chinese paper money (so-called) in some ruins in Mongolia.

In April, 1922, thirty gold coins (staters, of the time of Crœsus) were found near Smyrna, Asia Minor. Chemists of to-day tell us that, as determined by an analysis of another stater of their kind, the coins are 98.13 per cent fine and, also, contain about 1.6 per cent silver. The average weight of the 30 gold coins is reported to be 8.05 grams each, which, at 98.13 per cent gold, is 121.92 grains of pure gold, or five and one-quarter dollars of the United States.

But by what method can we figure the present money value of the so-called paper money of the ancient Chinese? It has no value as money, though some people might value it as a curiosity.

Does not this contrast explain, very lucidly, the necessity for employing one word for metal-money and another word for what is almost universally but erroneously called "money," but which, in reality, simply consists of words and numerals printed upon paper, together comprising promises made or implied? To illustrate, does the German word "mark" mean a weight of gold or other metal, or does it mean a scrap of, practically, worthless paper? Also, does the Russian word "ruble" means a weight of gold, or does it mean what is, virtually, a promise to pay gold?

Ambiguity is not permissible in scientific matters: precise and correct phraseology is required.

Again, in the twenty-third chapter of Genesis it is related that Abraham weighed to Ephron four hundred shekels of silver, current *money* with the merchant. It may be safely assumed that coins did not exist in those days (about 1860 B. C., according to Biblical chronology), because, if coins were in use at

that time and place, it would have been unnecessary for Abraham to have weighed the silver.

In 1918-1919 A. D., about 3,780 years later, Great Britain *weighed* to India 60 crores 77 lac 73,496½ rupees of silver, current *money* with the (Indian) merchant; not in payment for land, but for goods (jute, cotton and other goods) and services (of Indian soldiers) supplied by India to Great Britain during the World War.

It seems reasonable to suppose that India did not care to accept so-called *paper rupees* in payment for her goods (commodities) and services: probably her merchants preferred something that they considered to be more substantial. Hence, Great Britain agreed to pay India in silver; and, in that connection, the United States sold to Great Britain 270,121,554 standard silver dollars. These silver dollars were melted down, into silver ingots, bullion, and weighed to India in terms of rupees, because the word rupee conveys to the minds of the inhabitants of India an understanding of exchange value that is not conveyed to them by the word "dollar" or the word "ounce." Nevertheless, 60 crores 77 lacs 73,496½ rupees of silver is precisely the same weight or quantity of silver that is contained in 270,121,554 standard silver dollars, or in 208,922,139.42 ounces of fine silver.

Figure it out for yourself; a rupee is 165 grains of pure silver.

Finally, "Abraham *weighed* to Ephron four hundred shekels of silver, current *money* with the merchant." To illustrate, further, the difference between standard money (real money) and its substitute, the so-called "paper money," and for the purpose of emphasis, let us resort to hyperbole: the above quotation, if paraphrased in the euphuistic (?) vernacular of the unregenerate (society's substratum) does not say that Abraham flashed his roll, skinned off a few leaves of the long green and slipped them to Ephron. On the contrary, it states distinctly that Abraham *weighed* to Ephron four hundred shekels of silver, current *money* with the merchant.

Likewise, in paying for sundry supplies and services furnished to Great Britain by India, about 3,780 years later, the former *weighed* to the latter 607,773,496.5 rupees of silver, current *money* with the Indian merchant. India traded or bartered sundry commodities and services in exchange for silver, from Great Britain.

"As it was in the beginning, so it is *now*."

New York. W. DE L. BENEDICT.

The Iron Mountain Mine

THE EDITOR:

Sir—I have read with interest both the article in the issue of June 23, and Mr. Lavery's letter in the issue of July 21, regarding the Iron Mountain mine of Missouri, and feel that I can add some interesting facts to those already stated about this historical property.

The first attempt made to produce iron ore from this famous deposit was in 1836, when the Missouri Iron Co. was organized for that purpose. This company, however, never actually marketed any ore. In 1843 the next attempt was made, and the American Iron Mountain Co. was incorporated, and finally in 1844 mining of surface ore began in a desultory manner.

On May 10, 1869, the Iron Mountain Co. was organized by men of financial strength, and immediately thereafter mining of the ore was, for the first time, actively pushed and production increased rapidly. The largest annual production was reached in 1872, when it was approximately 270,000 tons. After that, production fell off rapidly and averaged about 100,000 tons annually during the succeeding ten years. During 1886 and 1887 the production doubled and went considerably above 100,000 tons annually, but immediately thereafter fell to an average of about 50,000 tons per year until 1902. From this last date until 1919 some ore was produced nearly every year, and the output averaged about 10,000 tons per year for this period. This small production was practically all from sorting and washing old dumps, with a little surface mining and mining from an occasional narrow streak of ore left in the old workings.

The Iron Mountain Co. sold its property about 1900 and went out of existence. From that time until 1920 the property changed hands several times without anything of consequence being done with it except the mining of ore left behind by the old company and some farming upon portions of the property suitable for such work.

The reason for the old company discontinuing operations was because its management could no longer mine and produce the ore at a profit and not because there was no more ore to be had. After the rich and easily mined Lake Superior ores were discovered and commenced to be mined in enormous tonnages the price for Iron Mountain ore dropped to less than $2 per ton at the mine. The ore could not be produced, let alone shipped anywhere, for this figure, and the cost of producing was going up and not down.

My former business associate, Prof. William B. Potter, had complete charge of the development and mining of this deposit during the active years of the property. He advised the old company to close down the property at a time when the conditions were such that no profit could be realized in operating it, although drill holes showed the probability of more or less ore extending out from the mountain under the valley. But underground mining was too expensive in those days to go after the ore that was left at the prices then prevailing. It was never reported by him that the property contained no more ore of satisfactory metallurgical grade.

Early in 1920 I was engaged by parties holding this property under option to make a careful examination of the present condition of the property and to study over all information obtainable and to make a report as to how much marketable ore was in sight and likely to be developed by further work. A few drill holes had been drilled just then that showed a fair-sized body of high-grade ore dipping under the valley at one point close to the old workings, and a new shaft had just been sunk into this body. The results of this examination showed that there were still large dumps of ore below market grade which with modern machinery could be washed inexpensively and brought to a good grade.

I estimated that 500,000 tons of salable ore could be produced from sources in sight. Also that the ore to be obtained by further working of the property could be placed as high as 1,000,000 tons, with the possibility of future developments leading to a production of several times this amount.

It was a few weeks after I completed this report that the property changed hands to its present ownership. ROBERT W. BARRELL.

St. Louis, Mo.

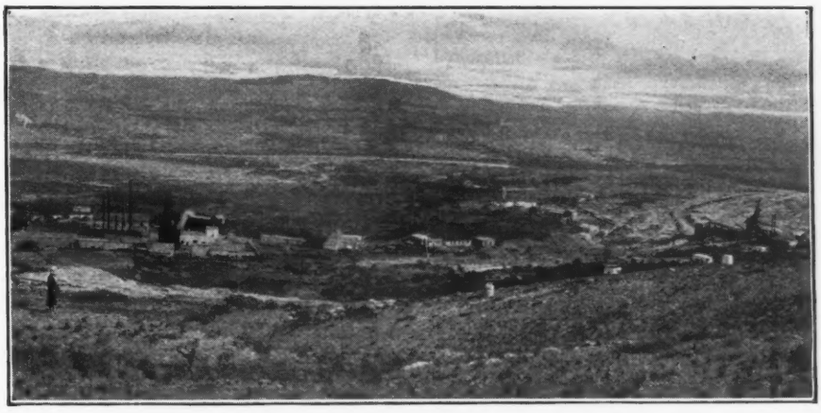
The Scientific Search for Ore

By T. A. Rickard

THE finding of ore is the first step in mining, and therefore the most important. To this task the geologist is devoting himself with increasing earnestness, for his ability to find ore is the measure of his industrial usefulness. There was a time when the geologist disdained anything so utilitarian; in its adolescence the science of Lyell and Murchison was deemed to be degraded by subserving the making of money; the geologist was an amateur in the strictest sense of the word. All that has been changed; the geologist today is expected to apply his theory to practice; he must make good his scientific research by giving a helping hand to the miner. Among the notable contributions of the modern geologist have been his interpretation of faulting and his exposition of the idea of secondary enrichment, but he has failed as yet in his most important functions—as a guide in prospecting. His appraisal of a prospect remains a faltering guess. Can he develop a scientific method whereby the presence or absence of ore underground can be inferred from an examination of the surficial rock?

During the last three years several geologists, led by Mr. Charles H. White, formerly professor of mining at Harvard, have been seeking the requisite criteria. During this time Mr. White has been associated in consulting practice in San Francisco with Mr. Augustus Locke, who has devoted himself to the subject with equal enthusiasm. Mr. White started a systematic study of the relationship between weathered rock and the ore below by examining 500 specimens from a tract of sixteen acres at Tyrone, a copper district in Arizona. Half of the specimens came from rock above ore-bearing ground, the other half from rock that did not overlie ore. Could a relationship be established between the cap and the ore, to serve as a criterion in the search for similar ore elsewhere? Six technicians interpreted the results of their separate examinations of the set of specimens, and the judgment of only one of then—Mr. White—showed a slight preference for the area overlying the places where ore had been found by exploratory work underground. Despite this discouragement, Mr. White went to Tyrone and continued this study, with better results. Meanwhile a fresh examination of the Tyrone specimens by three other technicians, notably Dr. H. W. Morse, yielded decisive conclusions, the majority of the specimens being selected by them correctly—that is, in conformity with the distribution of the ore underground, as disclosed by mine workings. Two of these men examined a further set of 7,000 specimens of rock from the same locality, and their separate judgments agreed closely; they were able to select the specimens that came from barren ground that covered the orebodies. This was done by noting the proportion of voids left by the leaching of sulphides, such volume of voids indicating the original amount of total sulphides of both iron and copper. The amount of residual limonite in the cap was taken as indicating the amount of original sulphide iron; and the distribution of this residual limonite, whether within the cavities or outside them, served to indicate the ratio of copper to iron in the original ore of what is now the cap. The successful interpretation of such evidence calls for the ability to create a mental picture of the process of oxidation; it involves the need for a knowledge of chemistry at least as thorough as that of geology; it constitutes an excellent example of the best type of scientific research. A man properly equipped for such work can give a reason for his conclusions; he can write the chemical reactions on which they are based; he is not dependent upon "hunches," or impulses. It appears highly probable that certain principles may be established whereby the careful examination of a barren cap may lead to a trustworthy quantitative judgment of the grade of the ore from which it was derived. An experienced observer in a district that is familiar to him can tell whence a piece of cap has come; it is not a long step to a generalized induction as to whether certain vestigial signs indicate that the cap was ore formerly. The necessary technique will include the chemical analysis of specimens and the use of the microscope; also, the determination of densities, of the volume of voids, of neutralizers. The methods will not be new, but they call for uncommon scientific knowledge and for men of the strictest intellectual honesty. It is a fact not generally recognized that many of the appraisals of prospects are based on subconscious observations, which are credited usually to instinct or experience, and not to the conscious observations recorded in the text of a report. To make real progress in this matter of ore hunting, as in any scientific research, it is necessary to be honest intellectually: to be able to give a reason for a conclusion, so that the same ratiocination may be repeated successfully elsewhere. The test of science is prediction.

The economic aspect of the inquiry needs no emphasis. The geologist is placing his opinion in competition with diamond drilling and shaft sinking; how much is his opinion worth as against the evidence obtainable from the costly cross-sectioning of the ground? We may hope that some day it will be cheaper to pay a geologist $5,000 than to spend $10,000 in drilling, but that day will not come until the geologic diagnosis needs no confirmation by the drilling. Our friends will be wise in going slowly, remembering the premature conclusions that were announced concerning the secondary enrichment of copper ores by chalcocite. The excessive emphasis placed upon chalcocitization as a criterion of secondary enrichment has made mine operators sceptical of similar scientific conclusions. My readers will remember that a group of copper-mining companies financed this investigation of chalcocite ores by specialists on the assurance that a study of secondary enrichment would prove of immediate usefulness. An immense accumulation of data resulted, but the information remains undigested and therefore is of no use yet. It is now ten years old. The disappointment makes it necessary for geologists to be wary in advocating any new departure in the art of ore finding. Mr Locke and his friends are well aware of this; they are soliciting the help of others, in the hope that not only may the criteria already recognized be submitted to systematic criticism, but that the examination of sets of specimens from known mining localities may prompt the detection of new clues. Those who are interested are invited to communicate with Mr. Locke, whose address is the Mills Building, San Francisco.



Panorama of Mina Tiro General looking north. Steel headframes mark approximate limits of oreshoot.

Driving a 1,200-Ft. Waste-pass

How the Problem of Filling Stopes With Waste at Reasonable Cost Was Solved When Working Conditions Became Difficult

By Charles Francis Williams
Chief Engineer Charcas Unit, American Smelting & Refining Co., San Luis Potosi, Mexico

AT THE CHARCAS UNIT of the National Metallurgical Co., in San Luis Potosi, Mexico, the problem of placing waste filling in the stopes at a cost commenurate with the value of the ore removed has been of increasing importance as greater depths and stoping widths are attained. The present stoping activities are localized between the eighth and tenth levels, and the major part of the ore reserves lie below the ninth level. At this point the oreshoot is about 1,300 ft. long and will average 30 ft. in width over a considerable portion of its developed length.

Flat-back Stoping Most Suitable

The cost of timber for square-setting in this remote and semi-desert section limits the use of this method of mining. The pronounced tendency of the granite-porphyry vein walls to slab, and the advisability of partially sorting the ore in the stopes because of the occurrence of low-grade areas in the vein, militate against shrinkage methods. Rill stopes fail because the large number of stulls and pillars required to support the walls and back greatly interfere with the handling of ore and fill material in the stopes.

Mining in the wide Combination vein below the eighth level is by flat-back overhand stopes with contemporaneous filling. The level interval is about 100 ft., and waste is dumped into the stopes through raises put up to the level above on 100-ft. centers. In the stopes it is distributed by barrows.

Stope filling has in the past been secured from mined-out and filled stopes in the upper levels; from waste stopes in the hanging wall of the vein; from waste from development work; from waste dumps at the surface; from low-grade parts of the vein estimated at 10 per cent of the rock broken; and, most important, from waste raises connecting with glory holes at the surface.

In the first method, fill drawn from the old workings was trammed several times from raise to winze before reaching the stope and was not available in the quantities required. Mining in the porphyry areas of the hanging wall of the vein was expensive, as the rock does not cave and run readily, and large amounts of dynamite were used. Waste from surface dumps lowered in mine cars was used only in emergencies.

Attempts to Reopen Old Waste-pass Fail

The mine was closed down in 1913 following a skirmish between the foreign staff defending the office building and the *insurrectos* surrounding it. The Americans escaped on a light engine under cover of darkness. At this time there were two waste-passes in use. One of these was near the middle of the oreshoot and supplied the greater part of the mine with fill. Following the episode of 1913 the mine was flooded, and this waste-pass was destroyed by the caving of the upper levels. The other waste-pass included an old shaft at the east end of the oreshoot. This shaft was used down to the second level, and from this point there was an opening through the old workings to the fifth level.

When the mine was reopened in 1919 this waste-pass was filled from the surface to the fifth level, and steps were taken to clean it out. Market conditions soon stopped all work, however, and it was not until 1922, when the mine was again reopened, that it was found impracticable to clean out this old hole from the fifth level, the only point of entry.

A new raise was then started from the fifth to the second level about 50 ft. east of the old opening. When the second level was opened up, old stopes were uncovered just below it, the existence of which was not known. As these workings were in line with the new raise, the second project had to be abandoned.

While efforts were being made to reopen a waste-pass through the upper workings, the work of opening up the lower levels, which were caved due to the closing down and watering up of the mine during the revolu-

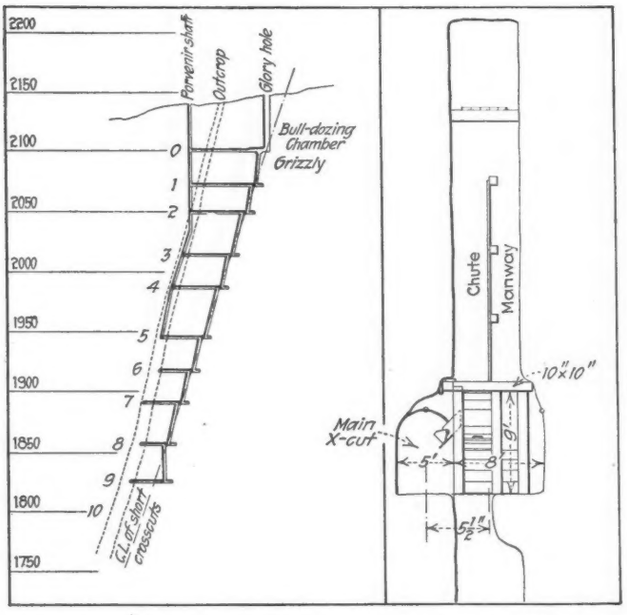


Fig. 1 (left)—Transverse projection of Porvenir waste-pass. Vertical plane of projection N. 19° 44″ 30′ E. through centers of shaft and winze. Fig. 2—Longitudinal section through raise, looking south, showing details of construction.

tion, had progressed. It was then determined to drive a series of raises in the footwall about 150 ft. south of the vein, as is illustrated by Fig. 1, the plane of the raises being equidistant from the main hoisting shafts at the east and west limits of the orebody.

Crosscuts to the raise points were started on the fifth, sixth, seventh, eighth, and ninth levels, and the centrally located porvenir shaft, a single-compartment vertical and inclined shaft down to the fifth level, was cleaned out preparatory to driving the crosscuts to the raise points above the fifth level.

It was thought inadvisable to drive a single raise a greater distance than would be required to connect with any two levels, not only because waste for filling might be required on the upper levels in future mining operations but because the raises might become clogged, and the labor of freeing them increased with their greater length.

The center line of the floor of the short crosscut 2½ ft. either way from the raise openings (Fig. 3) passes through a line making an angle of 70 deg. with the plane of the surface and roughly parallel to the dip of the vein. The raises follow this line at right angles to the strike of the vein to a point within 150 ft. of the surface. Here the last raise funnels out under a grizzly in a bulldozing chamber. This chamber is at the bottom of a vertical shaft sunk from the surface because of the limited capacity of the Porvenir shaft, through which the waste from the first and second level crosscuts and raises was being hoisted. About this 150-ft. shaft centers the glory hole where the waste for filling is mined.

Owing to bad ground, the ninth level crosscut was extended past the raise point and the raise carried up vertically. Though numerous natural caves were met in the limestone of the upper levels, this was the only important divergence from the plan of the waste-pass as originally laid out.

After passing through several feet of caliche at the surface, the waste-pass enters crystalline limestone, which becomes highly silicified in depth, containing dikes and stringers of porphyry. The granite-porphyry intrusive is penetrated below the fourth level and the lower raises were driven in the porphyry. This extensive development in the footwall of the vein disclosed no ore worthy of note. It demonstrated, however, the remarkable accuracy of the company's geological maps made by J. E. Spurr & Co. more than ten years ago at a time when there was practically no development in the footwall in this part of the mine.

All raises were started from the south side of a crosscut 8 ft. in length and driven at right angles to the main crosscut. Thus there were two vertical parallel planes of construction, one on the center lines of the main crosscuts and the other 5.5 ft. west on the center lines of the raises (Fig. 2). The crosscuts are 5x7 ft. and the raises 6x8 ft., with the greater dimension perpendicular to the plane of flow.

Standard two-way chute sets with sheet-steel chutes and gates, as shown in Fig. 3, are used at present, but may be altered later to use a sliding gate. The chute in the short crosscut is provided with an apron to facilitate passing waste to the raise from the next level coming up on the north side of this crosscut. The other chute extends into the main crosscut, which has been continued beyond the chute for 25 ft. to provide for car storage in tramming from this chute to stopes filled from this level. The chute gates are of the Morenci type and were made from drawings furnished by Frank Ayer, superintendent for the Moctezuma Copper Co.

The raises, as stated before, were put up from short crosscuts which were first enlarged to make room for

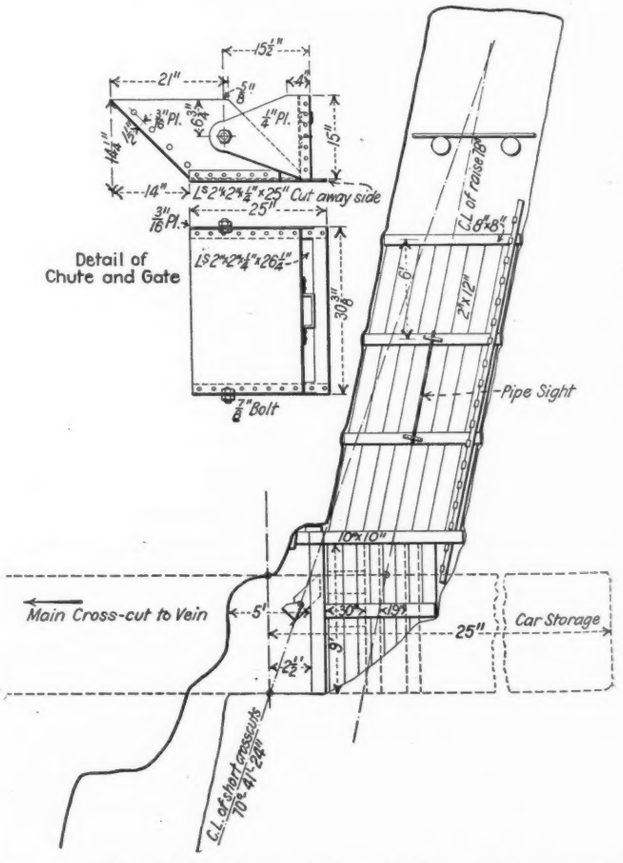


Fig. 3—Longitudinal section, looking east, through raise showing details of construction

the five outside posts of the 10-ft. chute sets. The inclination of the raises varied with the distance between levels, but averaged about 78 deg. A temporary manway was made by carrying up 8x8-in. spreaders on 6-ft. centers with lagging on the chute side. When completed, the raise was stripped of all timber down to the chute set.

Some difficulty was experienced in keeping the raises on line and inclination, and a 7-ft. length of 1-in. pipe attached to two of the lower dividers by heavy clamps as shown in Fig. 3 was adapted as a sight. A pipe cap was placed on the pipe when not in use to prevent clog-

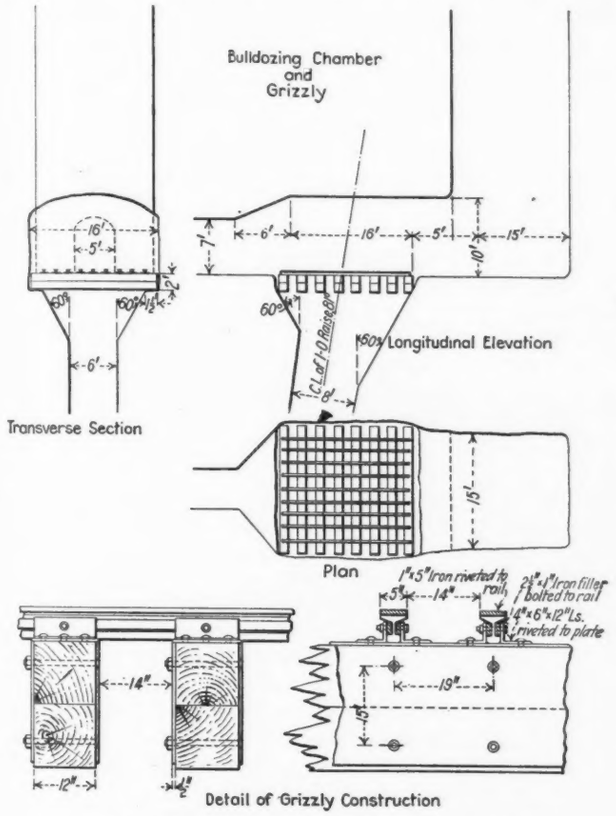


Fig. 4—Details of grizzly construction

ging. Besides being foolproof, this device enabled the shift boss to check up the alignment at any time.

The last round was drilled to break through with a hole just large enough to pass waste, thereby minimizing the possibility of accident at this point.

The 150-ft. vertical shaft from the surface to the bulldozing chamber was sunk 5x8 ft., and upon the completion of the raises, it was slabbed off to 15x15 ft. The bulldozing chamber and grizzly (Fig. 4) are of the Pilares type with minor modifications. The 80-lb. rails are inverted and held in place by short lengths of angle-iron riveted to the built-up web. The rails rest on timbers 12 in. wide and 24 in. deep. The timbers are covered with half-inch plate held in place by bolts. The grizzly is 16 ft. square with 14x14-in. openings and was copied from one used at Franklin Furnace by the New Jersey Zinc Co. Drawings for the bulldozing chamber were also furnished by Mr. Ayer.

To Scott H. Sherman, superintendent, under whose administration the waste-pass was constructed, I am indebted for the history of the older waste-passes, and to Samuel S. Slack, veteran tunnel contractor, who completed the job in record time, for his co-operation.

Method of Smelting Tin Concentrate in the Far East

The tin ore mined in Malaya and the East generally, is almost entirely alluvial, capable of being dressed to 72 per cent tin or better, and offering therefore little in the way of metallurgical problems to the smelter. For this reason, says a writer in the *Mining Journal*, practice in Penang is generally on conventional lines.

In the Malay Peninsula the Chinese smelt tin ore by a primitive method, in small clay shaft furnaces (known as "relau"), in which charcoal is used as the reducing agent, whereas European smelting companies use large reverberatory furnaces, coal being the reducing agent.

The following details of practice are supplied by the Eastern Smelting Co.: The tin ore is mixed with coal (anthracite), a little lime is sometimes added, and the whole is then fed into a reverberatory furnace through the charging doors. The charge is leveled by means of a long-handled rake (rabble) introduced through the charging or working doors; the doors are then closed tightly, and a regular fire is applied for from five to twelve hours. At the end of this period the fused mass is thoroughly stirred, this being done through the working door, the position of which, under the chimney, prevents the inrush of air from coming in contact with and oxidizing the tin. After this a strong heat is applied for one to two hours, and the charge is again stirred.

The reduction of the tin, as well as its separation from the slag, should now be complete. The tin is drawn off through the taphole into a float or kettle, from which it is ladled into molds, and the slag is run off into slag beds.

The products of this process are crude or furnace tin and slag. The slag, which is rich in tin, is again smelted, giving a poor tin, rich in iron, and a final slag, the tin content of which is negligible.

The crude tin drawn off from the furnace is usually impure, and contains different metals—e.g., iron, copper, lead, antimony, arsenic, and bismuth. As these impurities detract from the market value of the tin, it is necessary to remove them by a process of refining, which consists of liquation and "boiling" of the tin. The ingots of crude tin are melted down in a furnace at a low temperature, and the molten tin is allowed to run into a large iron pot or kettle, the less easily fusible metals remaining behind on the bed of the furnace. The tin which collects in the kettle is kept molten during the "boiling" by means of a fire underneath. The "boiling" consists of introducing into the bath of heated liquid metal a log of green wood. The wood, at the high temperature, undergoes dry distillation, and the gases and vapors given off set up a bubbling action in the bath of metal. By this means every portion of the mass is brought into contact with the air, the foreign metals and a portion of the tin being oxidized. The oxides collect together in a foamy mass, the so-called "boil-scum," on the surface of the metal. The duration of boiling depends on the state of purity to which it is desired to bring the tin; if a high degree of purity be required, the boiling must be continued for many hours. It is continued until the surface of the molten metal, after removal of the scum, is bright and shining, after which the molten mass is allowed to stand for some time, in order that the heavy impurities in the tin, especially iron and copper, may settle to the bottom. After this the scum is skimmed off, and the refined metal is ladled into molds. It is then ready for the market as pure tin.

Getting Around The Labor Shortage

By Industrial Education of Employees They Are Enabled to Earn More and Recruiting of Forces Is Made Easier

By George L. Walker

A NEW METHOD of recruiting and holding labor and getting better working results has been developed by the managements of some of the copper mines in the Southwest. It is unique, and at first sight appears a rather doubtfully effective operating plan, yet it is increasing the output per man tremendously, advancing wages in proportion, and reducing production costs appreciably. In the mines which have thus far adopted it the workmen are strongly in favor of the new arrangement, and it has increased wages sufficiently so that it is attracting many union miners.

The essential feature of the plan is what the managements call "educational work." As it gains popularity —and it surely will—the efficiency men and almost everybody else probably will lay claim to having furnished the vital suggestion which led to its development. Naturally, it has evolved from the results of other experience and experiments.

Here is the plan and the way it is put in practice: In the mine office a careful analysis is made of the daily records of the amount of work done in every department of the operations, the end in view being to determine just what constitutes a day's work. What ordinarily has been accomplished is arrived at by computing on a per-man-per-shift basis. With special allowances made for hot places and wet places in the mine, a standard for a day's work is established. The next step is for the management to take the miners into its confidence as to the plan. Every part of the work possible is then let out to the miners on contract, but with the provision that the men in each group are to continue to be paid wages at the regular daily rate, whether or not they accomplish more than they had been accomplishing. It is thus a case of their getting their regular wages anyway, with a chance to earn more.

At first only a few of the men speed up sufficiently to earn any of the extra compensation which is paid for accomplishing more than the amount specified as a standard day's work. Some of them fall far short of the standard. At this point it costs the company more to get the work done than it did before.

Right here the management puts the "educational" factor of its plan in operation. It selects and gets together a number of expert miners, shovelers, timbermen, and the like—practical workmen who have demonstrated their ability to work faster and better than 95 per cent of the other workers commonly employed can. Men of this highly efficient type are engaged at better wages to teach others how to get increased results.

"Try it my way for a day or two and see if you can't get along faster," says one of these instructors to miners who have a contract to drive a drift, a 6x6-ft. horizontal opening through solid rock. He has them set the drilling machine up differently, change the positions and angles of the holes a little, and arranges the work so that they will avoid getting in one another's way. Then he shows them how to load the holes with dynamite so as to get the greatest breaking force. After he has followed this up until the men adopt his methods improved results begin to be achieved.

In stoping many miners of long experience were unable to keep their results up to the standard adopted. After making the changes pointed out, changes which did not call for any more physical effort whatever, such men soon discovered that they were earning extra pay.

From the moment the new plan was put in motion the managements strove unceasingly to assist the men employed on contracts to accomplish greater and greater results. For instance, it had been the custom for the men to go up out of the mine to the blacksmith shop after steel, and to the supply house for various tools, and somewhere else after their dynamite. They always had done this when working merely for day wages, and had done it on company time. All this is changed now. In one of these mines which I recently visited a supply depot has been established on each level where the men exchange dull steel for sharp steel, broken tools for new ones, and get their dynamite, fuse, and in fact everything except timbers, rails, and those few other things which are too bulky to be so handled. This is one of the time-saving arrangements; it greatly assists the men to earn extra pay, yet it is provided wholly at company expense.

A mining man intimately connected with the development of this plan says: "In 1919, before we put this plan in operation, the average advance made in drifting was 0.68 ft. per man-shift. Our educational work, with payment for extra results accomplished, had increased this average to 1.81 ft. per man-shift before the end of 1920. Just now, in the effort to increase production, we are breaking in a lot of men who never saw a mine before, yet we are keeping the average advance per man-shift up to 1.71 ft."

If there be any injustice in this new plan it certainly is not injustice to the mine workers, but injustice to the company. All of the expense of putting the plan in operation falls upon the company, yet it clearly is of far greater advantage to the employee than to the employer. The mining companies under consideration are taking men off the street, paying them full wages while they are being educated, and then giving them a bonus from the moment they become efficient. Yet the companies are doing this of their own free will, and they seem much pleased with the results. It is distinctly and wholly their own plan.

Perhaps the best thing about the plan is that it stimulates the workers to learn to get results. A lot of miners who have used their heads and learned where a hole should be drilled, at what angle and to what depth, to exert the greatest efficiency in breaking rock; others who discovered and developed the most effective way to set timbers, and even those who introduced brain work into shoveling dirt, are getting good pay now as experts. From these positions they are being moved ahead to fill others of greater responsibility. Before unionism became so strong it often happened that miners rose to be superintendents and general managers. This new plan is restoring such opportunities to the workers.

It should be possible to adapt this plan to a great many departments of industrial production and distribution. In view of the remarkable results it is showing, it seems well worth trying. The field for its application probably will be found a very wide one.

Instead of "firing" those who cannot do a full day's work, why not educate them? It is a means for overcoming the prevailing shortage of labor.

Marketing Molybdenum Products

Prosperity of Producers Dependent Upon the Growing Use of the Metal in the Steel Industries

By Alfred W. G. Wilson
Department of Mines, Canada

Alfred W. G. Wilson

PURE molybdenum is a white, ductile, and malleable metal having a specific gravity of 10 and capable of retaining a high polish. If made by the reduction of the oxide with hydrogen it appears as a gray metallic powder, which can be compressed under heat conditions into gray-colored bars, which are brittle. If the oxide is reduced with carbon an impure gray powder results, whose specific gravity varies a little in different lots above or below 8.75, owing to the presence of some carbon. The fusion point of the pure ductile metal has not been accurately determined, but it is near 2,500 deg. C.; the fusion point of the reduced oxide is somewhat lower. Industrially molybdenum is used as a metal, in association with iron as ferromolybdenum, for making steel alloys, and in chemical combination with certain other elements as molybdenum chemicals.

The ductility of metallic molybdenum increases when the metal is heated above a red temperature, and it is easily drawn into wires by a special process. It can also be rolled into sheets or tubes, and can be welded or forged when hot into special shapes.

Molybdenum wires are used as windings for electric-resistance furnaces, especially those of the tubular type. The metal readily oxidizes at temperatures near 600 deg. C., and therefore it is necessary to provide air insulation to protect furnace windings of this metal. The wire is also used to construct the spider which supports the incandescent tungsten filaments in several types of electric lamps. The plates used in many types of radiotrons for wireless telegraphy and telephony are made from rolled sheet. Molybdenum has a low coefficient of expansion and can be welded to pyrex glass, a property which makes wires of this metal adaptable to making plate standards, grids, and filament supports in these appliances.

Molybdenum is being used for various contact making and breaking devices where platinum points were formerly employed. It is also alloyed with tungsten to make points for spark plugs used in internal combustion engines.

The Coolidge voltage rectifier and X-ray tubes have certain parts made of molybdenum rods or wire, and the metal is also used for certain parts in constructing Roentgen-ray equipment.

The wire has been substituted for platinum in jewelry, being cheaper and possessing many of the same properties, such as softness, malleability, ductility, silvery lustre, brilliant white color when polished, freedom from tarnish under ordinary conditions, and ease of working. Gold coated and platinum coated molybdenum wires are made for dental service, and coated wires are also used for other purposes where the uncoated metal would be subject to oxidation, or where relatively cheaper products are desired.

Molybdenum is alloyed with cobalt and chromium in different proportions to make a series of alloys, known commercially as molybdenum stellites, which are remarkable for their hardness, for their brilliant silver-white lustre when polished, and for their acid resisting qualities. These non-ferrous alloys are insoluble in nitric acid and are attacked only slowly by hydrochloric. Stellite alloys of this class cannot be rolled, drawn, or forged, but they fuse readily and can be cast into the desired shapes and finished by grinding and polishing. They are used for making high-speed cutting tools, stainless cutlery, and other acid-resisting articles.

An acid-proof steel has been made containing only 35 per cent iron, about 3 per cent molybdenum, and 60 per cent chromium. The peculiar properties of "stainless" molybdenum steels may cause them to be used for a wider variety of purposes than at present. If tableware and cutlery can be successfully made of these alloys the product should be suitable for saws, chisels and other edged tools; for pans, kettles and other utensils; for pump shafts, propeller shafts and propellers for salt water boats, and similar applications.

The most important use of molybdenum is in the manufacture of alloy steels. The alloying metal is introduced into the steel either as ferromolybdenum or as calcium molybdate. Occasionally it is first alloyed with the addition of elements in proper proportion. Formerly steels were made by adding reduced oxide in powdered form; a uniform product could not be obtained in this way, presumably because of the presence of unreduced oxide and other impurities in the addition metal, and the method is not now employed. Commercial structural steels form the most important class of these alloy steels from the tonnage point of view. The commercial applications of molybdenum steel have been widening rapidly during recent years.

In preparing alloy steels, molybdenum is usually used in association with other alloying elements, such as chromium, cobalt, manganese, nickel, tungsten, or vanadium.

The more important types of these new commercial alloy steels are: carbon-molybdenum, chrome-molybdenum, chrome-nickel-molybdenum, chrome-vanadium-molybdenum, and nickel-molybdenum. These steels have been developed by substituting small amounts of molybdenum for a portion of the other elements in standard alloys. This substitution is stated to have increased both the tensile strength and the elastic ratio. There has been also an increase in the reduction area, which

is indicative both of toughness and machinability. High-molybdenum steels are those containing 1 per cent or more of this element. They are used for a limited number of kinds of high-speed tools, permanent magnets, self-hardening steels, rustless steels, acid-proof steels, stainless cutlery, and other special purposes.

Molybdenum Steel Grows in Favor

Low-molybdenum steels are those containing less than 1 per cent of the element alloyed with other metals in varying proportions. These steels are rapidly growing in favor for various mechanical purposes and structural uses. From a tonnage point of view this group of alloy steels is the most important commercial structural steel group. Most of the production during the last few years was used in forging or pressing automotive parts. The desirable properties of these steels have broadened the market and the products now made include armor plate, railroad forgings, track bolts, air flasks, pneumatic hammers, parts of agricultural machinery, machinery forgings, piston rods, rods and wires for chains and ropes, pierced tubes, rolls, and sheet steels such as are used for scrapers, scoops, shovels, hoes, and similar tools.

The percentages of molybdenum used in the various classes of low-molybdenum steels vary from 0.15 to 0.5 per cent or higher. The presence of the molybdenum appears to stabilize the properties imparted by the other alloying elements present, widening the range of heat treatment and forging temperatures and increasing the toughness and durability.

Low-molybdenum commercial structural steels will undoubtedly absorb by far the greater proportion of molybdenum marketed during the next decade.

Basis for Sundry Commercial Chemicals

Three stable oxides of molybdenum are known, the sesquioxide (Mo_2O_3) being basic, the dioxide (MoO_2) neutral, and the trioxide (MoO_3) acid.

Commercially the trioxide is the basis of the manufacture of the other molybdenum chemicals. It is made by roasting the sulphide in iron pans. It can also be made by dissolving molybdenite in nitric acid. When required in pure form it is obtained by decomposing ammonium molybdate with sulphuric acid, and heating the resultant molybdic acid.

Ammonium molybdate is made by treating molybdic oxide with ammonium hydroxide. It is an important chemical reagent used for the determination of phosphorus in ores, fertilizers, and in iron and steel. It is also used in textile manufacturing for fireproofing fabrics, especially muslins, and it has been applied as a disinfectant to upholstering in railway carriages and other public places.

Sodium and potassium molybdates are made by the fusion of the trioxide with the corresponding carbonates. The sodium salt is used for imparting a blue color to silks and woolens in textile dyeing, and also for making some blue pottery glazes.

Molybdenum tannate is used with extract of logwood to produce fast brown to black colors in leather, silk, wool, and rubber goods.

Calcium molybdate is a white insoluble crystalline powder that is decomposed by mineral acids. It is made by the fusion of calcium oxide and a molybdenum ore. It is also made by fusing the ore with sodium sulphate, dissolving the resultant sodium molybdate, and precipitating calcium molybdate with lime. This compound has come into recent prominence as a cheaper material than ferromolybdenum for the production of molybdenum steels.

The statement that was given wide credence during the war that molybdic oxide was required as a stabilizer for cordite and other explosives is incorrect. It could have been used in this way, but cheaper satisfactory stabilizers are available and this oxide was not used for this purpose.

Principal Ores of Molybdenum

Metallic molybdenum is an artificial product and the element has never been found free in nature. The principal commercial ores contain either the mineral wulfenite (molybdate of lead) or molybdenite, the sulphide of molybdenum.

Wulfenite, lead molybdate ($PbMoO_4$) is a non-metallic mineral with a somewhat resinous lustre containing, when pure, 26.15 per cent molybdenum and 56.2 per cent lead. Its color varies from brown, gray, or white to nearly colorless on the one hand, or to olive green, yellowish, or orange-yellow on the other. Commercial ores containing this mineral have been produced in Austria, Jugoslavia, Spain, and in several of the western states, particularly Arizona, Colorado, and Nevada. Until recent years vein deposits of wulfenite in the western states constituted the most important domestic source of molybdenum for the manufacture of the chemical salts of this element. The ore can be concentrated by ordinary "table" methods.

Molybdenite, the bisulphide (MoS_2), is a soft opaque mineral with a gray metallic lustre, not unlike galena. It is greasy to feel and in appearance resembles graphite, with which it is frequently confused by prospectors.

Molybdenite ores are the most important commercial source of this metal. They have been found on all the continents and in many countries of the world. The mineral usually occurs in association with acid igneous rocks, such as granites or syenites, or with metamorphic rocks, such as schists and gneisses. It has also been found in some basic igneous rocks, and a few important deposits have been found in conglomerates and limestones. It is probable that these latter deposits owe their origin to the presence of near-by igneous intrusives.

In Australia and in several localities in the United States molybdenite is found in association with ores of bismuth and tungsten. In the northern and eastern part of the North American continent it is usually found in association with pyrites, pyrrhotite, and magnetite. It is probable that deposits of molybdenite are more widespread than those of tungsten or bismuth. High-grade oreshoots are usually small and erratically distributed. In recent years very large low-grade deposits of disseminated ores have been found in America, one of the most important of these being that on the southwestern slope of Bartlett Mountain, in Summit County, Colo., about thirteen miles northeast of Leadville. Commercial methods of concentrating low-grade molybdenite ores have been successfully developed, and it is to deposits of this type that we must look for continued and steady production. Although table concentration is not successful, ore containing less than 1 per cent of molybdenite can be concentrated by oil-flotation.

Sales of ores or concentrates may be either upon the unit basis or upon the percentage content of molybdenum, molybdenum sulphide, or molybdenum oxide present.

In America sales are almost invariably based on the pound for weight and on the percentage content of molybdenum sulphide if the ore is molybdenite, or on the percentage of molybdic oxide present if the ore is wulfenite. Occasionally the equivalent content of metallic molybdenum is specified in place of the sulphide or oxide. One part by weight of molybdenum is equivalent to 1.67 parts of the bisulphide, and 1.5 parts of the oxide; one part of the oxide is equivalent to 1.11 parts of the sulphide and to 0.67 parts of the metal; one part of the sulphide is equivalent to 0.6 parts of metallic molybdenum.

In Canada during the war period some ores and concentrates were purchased from small operators on a sliding scale of prices based on a unit of 1 per cent of the short ton, or 20 lb., and this unit has also been used in the United States.

In the purchase of these ores allowance is made only for the principal molybdenum containing mineral present, and not for secondary or accessory minerals containing the element that might be present in small amounts. A molybdenite ore might contain a little wulfenite or a little molybdite, for example, but that would not be included in the settlement, chiefly because most of it would be lost in concentrating. In the purchase of concentrate this condition does not necessarily prevail if the purchaser proposes to use it as it is, and payment might be made for the total molybdenum present, provided such settlements have been agreed upon when drawing the sales contract.

Where molybdenite ores are to be marketed which contain more than 0.5 per cent and not over 5 per cent molybdenum sulphide a purchasing mill would probably contract to pay for not less than 70 per cent of the contents on the basis of current markets rates, less a deduction for treatment, which would probably be $5 to $6 per ton, with certain penalties for excess of specified impurities above stated percentages. If the ore contained more than 5 per cent molybdenite payment would be made for a somewhat higher recovery than 70 per cent, but not above 92 per cent. This method of settlement is not established current practice because the business is new and is also intermittent, but the foregoing statements are based on a practice which was current during the war. At present it would probably be impossible to contract for the sale of raw ores anywhere in the United States or Canada.

Molybdenum ores are rarely sold as such. It is almost always necessary for the producer to concentrate the valuable constituents, partly to reduce freight costs to markets, and partly to enable him to meet buyers' requirements. Concentration may sometimes consist only in hand picking and assembling of large masses or plates of the valuable mineral, this being especially true in the case of the small producer; or it may consist of the more elaborate mill treatment in which the ore is crushed by breakers and rolls and the valuable minerals are recovered by washing or by flotation in some form.

Commercially it is practicable to use concentrate containing less than 85 per cent molybdenite, but it is obvious that freight and treatment charges will be relatively higher for low-grade products. Where the distance of transportation between the producer and consumer is relatively short, lower-grade products can be economically produced. Concentrates containing 65 per cent molybdenite and 25 per cent pyrite can be converted into ferromolybdenum economically, but the consumer usually desires to obtain a higher-grade product. Concentrates containing less that 65 per cent molybdenite should be re-treated to raise the grade unless a buyer has been found who will specifically contract to accept such shipments.

THE largest known deposit of molybdenite ore lies within the United States, and other large reserves are also known to exist. The present tariff makes it unprofitable for most foreign producers to market their ores in the United States. It is therefore probable that the domestic demand for low-molybdenum steel will stimulate renewed activity in the mining of ores of this metal within the borders of the Union. A demand for additional supplies will probably be of slower growth, and be largely dependent upon the requirements of foreign steel makers.

Ore contracts usually provide for a sliding scale of payments for shipments which run above or below the standard upon which market quotations are based. Contracts always contain definite price agreements fixed at the time of sale; price agreements are not based upon current market quotations of the date of delivery or any time thereafter. There does not appear to be any standard practice as regards the time of payment for deliveries. Settlements for concentrates are subject to negotiation and would normally be 30 or 60 days after receipt of shipments. In some cases, where regular shipments are being received on a contract, settlement for a stated percentage of the contents might be made on receipt of consignments, the balance being paid in 30 or 60 days.

Market prices for concentrates are usually based on 85 per cent molybdenum sulphide content for molybdenite ores. The London prices are usually quoted on a price per unit (22.4 lb.) for 95 to 96 per cent concentrates. Wulfenite ores are usually bought or sold on the basis of the molybdic oxide present or on the equivalent molybdenum content; the market price will normally be based on the current price for molybdenum sulphide.

Purchasers of concentrates are of several classes: ore dealers or brokers who purchase for resale to consumers of concentrates, or who accept shipments for sale on a commission basis; chemical manufacturers who utilize them in their own works for making molybdenum chemicals for sale to wholesale distributors; manufacturers of metallic molybdenum for sale to makers of non-ferrous molybdenum alloys; makers of small rods, wires, or sheets; manufacturers of ferromolybdenum for sale to steel makers. Only in a very few instances are the final finished products which contain this metal made and sold by the purchaser of the original concentrates.

Naturally a purchaser of molybdenum concentrates prefers to obtain a product as free from other metals as possible. To what extent the presence of minerals containing other metals can be tolerated is still an open question. The presence of minerals containing anti-

mony, arsenic, bismuth, copper, nickel, or tin is considered undesirable; objection is made to the presence of any considerable quantity of minerals containing barium or calcium, other than silicates; minerals containing phosphorus are also undesirable. It is usually possible to eliminate undesirable non-metallic minerals by concentrating. Small amounts of metallic minerals will usually remain. Current practice appears to demand concentrates containing not over 1 per cent copper and 10 per cent iron, both of which are usually present as sulphides. Concentrates containing as high as 30 per cent iron in the form of pyrite have been successfully converted into marketable ferro, the iron present in the ore itself being utilized for making the ferro. War contracts in Australia allowed a maximum of 0.5 per cent bismuth and 0.5 per cent tin. The permissible content of copper varies from 0.2 per cent to 0.5 per cent, according to the needs of the buyer and to market conditions at the time of sale.

The maximum allowable impurities will depend upon the purpose for which the concentrate is required; the manufacturer of chemicals naturally demands a cleaner product than the producer of ferro. If molybdic acid is to be made by using nitric acid the concentrates used must be as pure as possible to keep down the cost of making a pure product. If molybdic oxide is being made by roasting and solution in ammonia small quantities of arsenic, antimony, and bismuth would be harmless in the concentrates, as they would be volatilized in the process of treatment. Copper would be objectionable because its salt would be soluble in ammonia and would appear in the finished product; iron would be less objectionable and can be tolerated because it would be rendered insoluble by the treatment.

Ores that are to be used for making ferro or the metal tolerate more impurities than would be allowable in ores for making chemicals. Arsenic and bismuth will be volatilized; some copper would volatilize, but a small amount might remain in the ferro; tungsten would probably remain in the ferro; iron from pyrites can be retained in the ferro, a portion passing into the slag; sulphur is in part burned off and in part goes into slags, a small residue remaining in the ferro; non-metallic minerals go into the slag.

The presence of tungsten and copper in ferro required for the production of low-molybdenum steels has not been proven to be injurious. Ordinarily the amounts present in the ferro will be very small in proportion to the molybdenum; when still further diluted by iron in the production of steel the amounts present would be almost too small to be detected.

The following lists contain the names of the principal firms in the United States who utilize molybdenum concentrates. Producers of ferromolybdenum and producers of molybdenum chemicals are frequently purchasers of ores but not necessarily miners. A few firms whose names appear in these lists mine and concentrate their own ores, and in some cases they sell concentrate as well as manufacture molybdenum products. Firms who do not advertise their products in the current technical press may not be included in these lists for obvious reasons. It is not always possible, also, to distinguish producers from dealers only.

Dealers in Molybdenite

American Metal Co., New York, N. Y.
Atkins, Kroll and Co., San Francisco, Calif.
Climax Molybdenum Co., New York, N. Y.
Foote Mineral Co., Philadelphia, Pa.
Charles Hardy and Ruperti, New York, N. Y.
Southern China Development Syndicate, New York, N. Y.

Producers of or Dealers in Ferromolybdenum

American Metal Co., New York, N. Y.
Climax Molybdenum Co., New York, N. Y.
Electric Reduction Co., Washington, Pa.
Electro Metallurgical Co., Niagara Falls, N. Y.
Foote Mineral Co., Philadelphia, Pa.
E. J. Lavino and Co., Philadelphia, Pa.
Metal and Thermit Corporation, New York, N. Y.
Molybdenum Corporation of America, Washington, Pa.
Shimer and Co., Philadelphia, Pa.
Taylor and David, 56 Pine Street, New York, N. Y.
United States Molybdenum Metal Co., Ltd., Vancouver, Wash.
Vanadium Company of America, New York, N. Y.
H. A. Watson and Co., New York, N. Y.
York Alloy Co., York, Pa.
J. W. Evans, Belleville, Ontario.
Lamble Brothers, Orillia, Ontario.

Producers of Molybdenum Metal

David Atkins, New York, N. Y.
E. P. Earle, New York, N. Y.
Fansteel Products Co., North Chicago, Ill.
Foote Mineral Co., Philadelphia, Pa.
Guitermann, Rosenfeld and Co., New York, N. Y.
Metal and Thermit Corporation, New York, N. Y.
Rare Metals Products Co., Belleville, N. J.
Lamble Brothers, Orillia, Ontario.

Producers of Molybdenum Wire

Fansteel Products Co., North Chicago, Ill.
Foote Mineral Co., Philadelphia, Pa.
General Electric Co., Schenectady, N. Y.
Herman A. Holz, New York, N. Y.
Independent Lamp and Wire Co., Weehawken, N. J.
Westinghouse Electric and Manufacturing Co., East Pittsburgh, Pa.

Manufacturers of Alloy Steels or Stellite

Steels
Atlas Steel Corporation, Dunkirk, N. Y.
Bethlehem Steel Co., Bethlehem, Pa.
Carbon Steel Co., Pittsburgh, Pa.
Carnegie Steel Co., Pittsburgh, Pa.
Central Steel Co., Massillon, Ohio.
Crucible Steel Co. of America, New York, N. Y.
Cutler Steel Co., Pittsburgh, Pa.
Electric Alloy Steel Co., Youngstown, Ohio.
Fansteel Products Co., North Chicago, Ill.
Interstate Iron and Steel Co., Chicago, Ill.
Pennsylvania Forge Co., Philadelphia, Pa.
Sandvik Steel Co., New York, N. Y.
Tacony Steel Co., Philadelphia, Pa.
United Alloy Steel Corporation, Canton, Ohio.
Wheeling Mold and Foundry Co., Wheeling, West Virginia.
Dominion Alloy Steel Corporation, Ltd., Sarnia, Ontario.

Stellite
Haynes Stellite Co., New York, N. Y.
Deloro Smelting and Refining Co., Deloro, Ontario.

Manufacturers of Molybdenum Chemicals

David J. Atkins, New York, N. Y.
Baker Chemical Co., Phillipsburg, N. J.
Binney and Smith Co., 41 East 42nd St., New York, N. Y.
Chemical Products Co., Denver, Colo.
Ralph L. Crosthwaite Co., Inc., 15 Park Row, New York, N. Y.
Denver Fire Clay Co., Denver, Colo.
Alexander G. Fergusson, Jr., 480 Chestnut St., Philadelphia, Pa.
Foote Mineral Co., Philadelphia, Pa.
Grasselli Chemical Co., Cleveland, Ohio.
Hummel and Robinson Corporation, 90 West St., New York, N. Y.
Marshall Rieha Incorporated, Baltimore, Md.
Merck and Co., New York, N. Y.
The Mine and Smelter Supply Co., 42 Broadway, New York, N. Y.
Powers-Weightman-Rosengarten Co., 9th and Parrish Sts., Philadelphia, Pa.
Rare Metals Products Co., Belleville, N. J.
Steel Alloys Co., Los Angeles, Calif.
The Will Corporation, 845 Maple St., Rochester, N. Y.
York Metal and Alloys Co., 56 Pine St., New York, N. Y.
J. W. Evans, Belleville, Ontario.
Lamble Brothers, Orillia, Ontario.

European practice in marketing ores of the rarer metals differs somewhat from the practice in America, where there are relatively fewer ore brokers. European consignments from foreign producers are generally handled by brokers who distribute them to a clientele. A few of the larger firms buy directly or through accredited agents; no list of these is available. Some of the principal dealers in molybdenum ores and concentrates in the United Kingdom and on the Continent are listed herewith:

European Buyers of Molybdenum Ore

Henry Bath and Son, Ltd., Exchange Bldg., Liverpool, England.
Cookson, Budd and Co., Ltd., Newcastle-on-Tyne, England.
Everitt and Co., Ltd., 40 Chapel St., Liverpool, England.
Johnson, Matthey and Co., Ltd., Hatton Garden, London, E. C. 1, England.
O. T. Lempriere and Co., 1 Queen Victoria St., London, E. C. 4, England.
L. Le Personne and Co., 99 Cannon St., London, E. C. 4, England.
Metallgesellschaft, Frankfurt-on-Main, Germany.
Palmer, Marchant and Co., 7 East India Ave., Leadenhall St., London, E. C. 3, England.
Rochette Freres, Paris, France.
Siegfried Pels, 26/28 Neuerwall, Hamburg, Germany.
Société Général des Minerais, 31 Rue du Marais, Brussels, Belgium.

It has never been possible to compile a reliable table showing the world's production of molybdenum contained in ores that have been mined and sold as such, or have been concentrated before sale. No uniform system of reporting sales, weights, ore contracts, or prices has been employed by government bureaus. Many sales are reported without any statement as to the percentage content of the ore and without reference to the unit price or contract terms. All tables of the world's production of molybdenum that have been issued therefore represent both estimates and compromises based on published official data that are incomplete. Canadian statistics of production are based on the actual recovery of molybdenum sulphide; United States statistics are based on the calculated metallic contents of crude ore or concentrates, the actual recovery of mineral or metal not being recorded.

Small quantities of molybdenum ore were produced in Queensland, Scandinavia, and the United States prior to 1900. In 1880 Sweden sold 1,400 lb. of 95 per cent sulphide concentrates, and about five tons of 9 per cent sulphide ore was exported to Germany; in 1898 eight tons of molybdenite concentrates and twelve tons of wulfenite ore were produced in Arizona and New Mexico, but the metallic contents are not recorded. These appear to be the first records of production of the ores of this metal. Molybdenite was discovered in Canada in 1852 and the first recorded shipment, consisting of picked ore and flake, was made in 1902.

A new table showing the world's production of molybdenite, or the equivalent where other ores were sold, has been compiled by V. L. Eardley-Wilmot for publication in a forthcoming monograph on this metal[1]. The world's total production of molybdenum ores to the end of 1913, in terms of molybdenite, is estimated by Mr. Wilmot to have been 1,508.5 short tons, valued at $1,033,764. The production is distributed as follows:

Country	Tons	Value
Canada	1.4	$1,775
United States	105.0	74,150
Japan	4.5	2,603
Queensland	860.0	602,340
New South Wales	300.0	208,460
Norway	224.6	138,800
Miscellaneous	13.0	5,606
	1,508.5	$1,033,764

In another table, also compiled on the basis of molybdenum sulphide present in ores or concentrates sold, Mr. Wilmot estimates the total world's production between the years 1914 and 1920 at 3,864.6 short tons, valued at $9,223,016 at the time of sale. In addition there were sales of wulfenite ore from Spain and Jugoslavia which amounted to 1,823.6 tons, and small productions in Germany and Austria which are not recorded, with the exception of about fourteen tons of molybdenite from Saxony. The total Canadian production during the years 1914 to 1920 was 470.1 tons of molybdenite, valued at $1,037,315, the maximum production in any one year being 189.2 tons in 1918. The total United States production during this period was the equivalent of 1,548.3 tons of molybdenite, valued at $2,429,234, the maximum production being 650.1 tons in 1918.

At the close of the war there were large stocks of molybdenum ores available either in the hands of the producers or under contract to consumers. When the war demand ceased production was curtailed and finally stopped. During the last three years there has been no systematic production, but prospecting work in some localities has yielded small lots of ore, some of which have been marketed in Europe and a little in the United States. The uses of molybdenum in low-molybdenum steel have been increasing, war stocks have been gradually absorbed and utilized, and it is probable that broadening the market will stimulate further production.

FUTURE prices for molybdenum and its alloys will naturally depend upon supply and demand. A supply sufficient to meet all ordinary demands will be assured to steel manufacturers and other consumers only if they show a readiness to contract at prices which will yield a profit to the producer. Prices that have been obtained by producers since the expiration or cancellations of war contracts have been in nearly every case below cost of production. . . . It is doubtful if many possible producers in America can operate with prices less than 85c. per lb. for molybdenite concentrates.

The largest known deposit of molybdenite ore lies within the United States, and other large reserves are also known to exist. The present tariff makes it unprofitable for most foreign producers to market their ores in the United States. It is therefore probable that the domestic demand for low molybdenum steel will stimulate renewed activity in the mining of ores of this metal within the borders of the Union. A demand for additional supplies of these ores from mines outside the Union will probably be of slower growth, dependent upon the requirements of foreign steel makers.

The tonnage of molybdenum steels produced in the United States now forms a very appreciable percentage of the total alloy-steel production and the consumption appears to be increasing steadily. During the recent hearings on general tariff revision at Washington, Clifton Taylor, representing the Molybdenum Corporation of America, Pittsburgh, stated that at least half of the steels for the automobile business will be molybdenum steels, estimating the requirements at about 1,000,000 tons of molybdenum steel per annum.[2] This would represent a consumption of about 8,000,000 lb. of metallic molybdenum, chiefly in the form of 65 per cent ferro, by this industry alone. The production of this amount of metal would necessitate the mining and milling of approximately 1,350,000 tons of ore containing 1 per cent of molybdenite, yielding nearly 8,000 tons of 85 per cent concentrate.

Owing to the spasmodic production and limited demand for molybdenum ore, prices were irregular prior to 1914. Usually there were no regular quotations, the minerals or concentrates being sold in small lots either under contract or to the highest bidder. Prices varied

[1] "Molybdenum," by V. L. Eardley-Wilmot, Mines Branch, Ottawa, in press.

[2] Hearings on General Tariff Revision before the Committee on Ways and Means, House of Representatives, 1921, Part II, Schedule C, p. 746.

during the first ten years of the present century between 15 and 30c. per pound for 92 per cent concentrate. In 1914, persumably on account of the heavy German buying, the prices in the United States rose from $1.25 to $6 per pound of molybdenum sulphide contained. New York quotations during 1915-1916 rose to $2 per pound. In 1917 the average price was $1.80 per pound for 90 per cent sulphide concentrates; this rose to $2.95 in May, was $2.15 in June, and stood at $2.25 for the balance of the year. Prices during these years were subject to war conditions, and in Norway, during 1917, 75 per cent concentrates were purchased at a contract price the equivalent of $4 per pound of contained molybdenite.

After the armistice the market collapsed and prices declined to 85c. per pound at the end of 1918. In 1919 quotations ranged from 65c. to 85c. throughout the year and forced sales took place at 50c. and even 40c. per pound. In 1920 and 1921 New York prices were nominal at 75-85c. per pound of molybdenum sulphide in 85 per cent concentrate. New York prices during 1922 were largely nominal at 45 to 50c. per pound for 85 per cent sulphide concentrate. In October and November they had risen to 55-60c., and in December to 70c. During the first months of 1923 they have remained at 65 to 75c. per pound for 85 per cent concentrates and are nominal.

Ferromolybdenum is quoted at a price per pound for the contained molybdenum. In 1904 quotations per pound of ferro were $1 and upward according to quality; metal was quoted at $2.75 per lb. f.o.b. New York. In 1910 quotations were $1.40 to $1.50 per pound of contained metal; during 1916 the price had risen to $3 to $4 per pound; in February, 1917, New York quotations were $4.35; since the war these have declined to $2 to $2.50.

Metallic molybdenum in rods and wire, 99.9 per cent pure, is sold at prices which vary according to the gage from $32 to $40 per pound. Molybdenum metal in powder form, 95 per cent, was quoted at $4.50 per pound in January, 1923, but in the month of February quotations had declined to $3.50 to $4 per pound.

Future prices for this metal and its alloys will naturally depend upon supply and demand. A supply sufficient to meet all ordinary demands will be assured to steel manufacturers and other consumers only if they show a readiness to contract at prices which will yield a profit to the producer. Prices that have been obtained by producers since the expiration or cancellations of war contracts have been in nearly every case below cost of production. Costs of production naturally vary greatly in different localities, but it is doubtful if many possible producers in America can operate with prices less than 85c. per pound for 85 per cent molybdenite concentrates. This is nearly the equivalent of $2.75 per pound for the molybdenum content of ferro. Large mines and properties where molybdenite is a byproduct can possibly be operated successfully on a lower market price. Such a price would add about $14 per ton to the cost of low-molybdenum steels containing 0.5 per cent molybdenum, equivalent to 0.7c. per pound to the cost of the finished steel, a very small amount to pay for the increased value of the product. The present tariff in the United States appears to make no appreciable increase in costs to the ultimate consumer of low-molybdenum steels, is distinctly protective, and is very unlikely to be a source of revenue. It will probably affect the cost of both ferro and metal by adding to the costs of the consumers of these products.

Steel makers outside the United States have not been so energetic in developing the commercial classes of steels into which this element enters. The increase in foreign demand for molybdenum products will therefore be of slower growth. The new United States tariff on molybdenum ores and concentrates practically closes this market to foreign ores. This tariff places a duty of 35c. per pound of metallic molybdenum contained in ore or concentrates. This is equivalent to 18c. per pound for 85 per cent concentrate. The duty on ferro and on all molybdenum alloys, salts, or compounds is 50c. per pound on the molybdenum contained therein and 15 per cent ad valorem.

Fire Again Plays a Devastating Part in the Coeur d'Alenes

Ruins of Hecla mine plant, Burke, Idaho, in distance

Solving Metallurgical Problems With the Reflecting Microscope

Much Information Regarding Mineral Associations and the Degree of Dissemination Has Been Thereby Easily Revealed

By G. M. Schwartz
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THE RECENT application of the methods of metallography to the study of the polished surfaces of opaque ores has led to a knowledge of ore deposition, enrichment, and alteration which has been of great value to the mining geologist. Descriptions of the geology of ore deposits are now scarcely considered complete without a study of the polished ores. The growth of this method has been rapid, as practically the first paper published was by William Campbell[1] in 1906. The publication of the first comprehensive paper on the copper ores by Graton and Murdoch[2] in 1913 has been followed by a number of papers dealing with many kinds of ores. These papers have dealt principally with the geologic aspects of the work, and the mining and metallurgical engineer is not as familiar with the value of the results as might be wished.

Several instances in which a study of polished surfaces has had a bearing on metallurgical problems have recently come to my attention. These have emphasized the possibilities of the work as an aid to the metallurgist, and it is proposed to indicate, by example, some of them. A detailed description of the methods of polishing and identification would be out of place here. These are treated in some detail in the latest book of determinative tables by Davy and Farnum.[3] Some suggestions on the general problem, more particularly as applied to mining geology, were made in an article by Ray.[4] The only paper dealing with the purely metallurgical side is by Head,[5] who applied the method to a study of head and tailing samples of a mill with special reference to data on treatment of the ore by flotation.

Some of the specific questions of the metallurgist regarding an ore, which may be answered by a study of polished surfaces, are:

1. What minerals carry the values? From this knowledge inferences as to the treatment may be made based on the chemical composition of the minerals.

2. What minerals are associated with the ore-bearing minerals? Several inferences as to the possibility of separation may be made with this data.

3. What is the state of aggregation of the various ore minerals in a complex ore? The mesh to which the ore must be ground may be inferred where differential flotation or other processes are to be used.

4. What is the textural relation of the ore and gangue minerals? From this the possibility of separation by mechanical means may be determined. The three examples described below indicate specific applications of data obtained in this way.

In examining copper-magnetite ores on which extensive magnetic concentration tests had been made with poor results, an unusual copper mineral was found associated with chalcopyrite. By means of the tables mentioned above the mineral was identified as chalmersite ($Cu\ Fe_2S_3$). This mineral is magnetic, and, furthermore, associated with it and chalcopyrite were considerable amounts of pyrrhotite (Fe_3S_4), which is also magnetic. Neither of these minerals could be seen in the hand specimen with ease, and the chalmersite could not be detected with a hand lens. The chalmersite and chalcopyrite formed a most intimate intergrowth (See Fig. 1). On the contrary, the mixture of copper sulphide and magnetite was rather coarse (See Fig. 2). With the above data at hand it becomes ob-

Fig. 1—Micrograph of the polished surface of an intergrowth of chalcopyrite (Cp) and chalmersite (Cm)

Note the fineness of the blades on the right-hand side. Magnification X75.

Fig. 2—Micrograph of an intergrowth of grains of magnetite (M) and chalcopyrite (Cp)

Here the texture is coarse and relatively coarse grinding may be expected to allow the separation of the two, but as chalmersite, as shown in Fig. 1, is intergrown with some of the chalcopyrite, magnetic concentration cannot be used. Magnification X70.

[1]Campbell, W. "The Microscopic Examination of Opaque Minerals," *Economic Geology*, Vol. I, 1906, p. 751.
[2]Graton, L. and Murdoch, J., "The Sulphide Ores of Copper." *Trans, A.I.M.E.*, Vol. 45, 1913, pp. 26-81.
[3]Davy, W. M. and Farnum, C. M., "Microscopic Examination of the Ore Minerals." McGraw-Hill Book Co., 1920.
[4]Ray, J. C., "The Reflecting Microscope in Mining Geology and Metallurgy." *Min. & Sci. Press*, June 6, 1914.
[5]Head, R. E., "Quantitative Microscopic Determination of Chalcopyrite, Bornite, and Pyrite, in a Porphyry Ore." *Reports of Investigations*. Bureau of Mines, June, 1921.

vious that magnetic concentration tests are unnecessary, as at best this method could give only an imperfect separation of the copper and iron, inasmuch as both chalmersite and pyrrhotite would tend to go with the magnetite. But Fig. 2 strongly indicates that relatively coarse grinding, followed by flotation, would probably give a reasonable separation. Tests could be carried out to determine the commercial possibilities of the process.

In another case the metallurgists desired to know the form in which silver occurred in a disseminated and siliceous lead-silver ore in which silver minerals could not be detected with a hand lens. Specimens assaying as high as 100 oz. of silver per ton apparently contained no silver minerals. Polished surfaces of the galena in the ore, when etched with nitric acid, showed inclusions of argentite (Ag_2S) which remained unetched. (See Fig. 3.) It was not at all certain that all of the silver in this ore occurred as the sulphide, but further work might serve to clear up the point. The knowledge that even part of the silver occurs as definite grains of sulphide should be of value. Even the information that much of the silver occurred so finely disseminated as to defy identification might assist the metallurgist in his problem.

In the third example a low-grade iron ore had defied attempts to concentrate it by the usual washing process, although apparently the material was similar to other ore which had been treated successfully. Examination of the polished surfaces of some of this ore showed fine

Fig. 3—Micrograph of an etched surface of polished galena showing inclusions of argentite (A)

Argentiferous galena often carries the silver in this form. Magnification X140.

grains of silica mixed with the iron oxide. (See Fig. 4.) Measurement of these grains showed them to average about 1/200 of an inch in diameter. To separate the silica grains from the iron oxides it would be necessary, presumably, to grind the material to about 200 mesh. This, on such an ore, is commercially impracticable, and there is little need of continuing the tests.

It should be emphasized that the application of the study of polished surfaces to metallurgical problems will not solve the problems, but it should give information invaluable to the metallurgist. In certain cases studies of this sort will indicate clearly that some methods are impracticable and that others are much more likely to succeed, and in any event the information obtained will enable the worker to proceed with a clearer

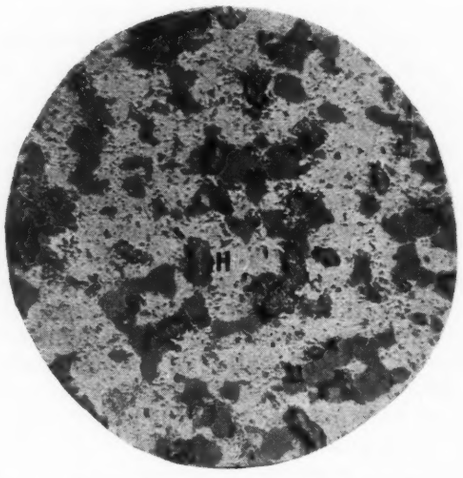


Fig. 4—Micrograph of an etched surface of lean iron ore showing silica grains (S) and iron oxide, chiefly hematite (H)

The silica grains are 1/200 of an inch or less in diameter. Magnification X150.

understanding of the problem with which he is confronted. Often much time and money might be saved by a little spent in a preliminary microscopic examination of the ores to be treated.

Mining in Oregon Active

Mining in Oregon during the first half of 1923 was fairly active, with development and prospecting in progress at a number of properties in both the southwestern and eastern parts of the state, according to the U. S. Geological Survey. With this development, the output from Oregon metal mines in 1923 may equal that in 1922, which was valued at about $829,800, of which gold amounted to $532,500, silver to $151,800, copper to $141,300, and lead to $4,200.

In eastern Oregon much work was done in expectation of the resumption of the Sumpter Valley smelter, which is scheduled to blow in soon. The mines in the Granite and Greenhorn districts have been particularly active in developing ore for shipment to the local smelter. The dredges on John Day and Powder rivers continued operations. The small boat on Burnt River was inactive, as a larger dredge is being installed. Hydraulic and sluice mining was approximately normal. The largest output in this region was made by the Iron Dyke, Bay Horse, and Cornucopia mines, and the Buffalo-Monitor should make a good output from its new flotation mill.

In southwestern Oregon there has been development at the Skyline, Sylvanite, Gold Ridge, and Millionaire mines, and two mills are being constructed. The development is said to promise well, but so far there has been no additional production from quartz mines in this part. The placer production of Jackson and Josephine counties will no doubt be comparable to that of 1922, though cold weather early in the season interfered to some extent with hydraulic work. It is understood that new equipment on the beaches might increase the output from Coos and Curry counties, but nothing definite has been heard recently of these activities.

An Occurrence of Carnotite Near Denver

Presence in Coal of Laramie Formation Indicates That as Possible Ore Horizon in Colorado—Deposit Apparently Not Commercial

By John H. Wilson

Assistant Geologist, Midwest Refining Co., Denver, Col.

RECENT DISCOVERIES of high-grade carnotite deposits in the Belgian Congo make it possible to produce radium at prices which prohibit the further operation of many of the lower-grade deposits in remote districts of Colorado. It is the purpose of this article to call attention to the occurrence of carnotite in the Laramie formation which outcrops along the Front Range of the Rocky Mountains and which is closely paralleled for many hundred miles by several railroads. Carnotite ore discovered in this formation could be mined and put on the market much below the cost of production of the mines in southwestern Colorado, which operate under limited transportation facilities and adverse climatic conditions.

The deposit referred to is near the center of Section 28, Range 70 West, Township 2 South, Sixth Principal Meridian, in the northern part of Jefferson County, Colo. The distance from Denver is about 12 miles.

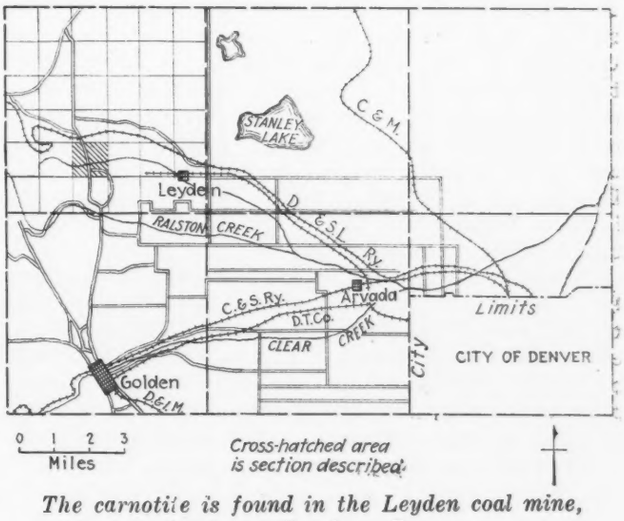
Uranium Ore First Noted Fifty Years Ago

The land on which the ore is found was entered under the homestead law on June 21, 1869, by Patrick Stanton. Other entries on land covering the outcrop of the formation in this section were made in 1866 and 1867. The coal occurring in the Laramie formation was worked through adits as early as 1870. On Nov. 24, 1874, Captain E. L. Berthoud was called upon to examine the Leyden coal mine. In making the examination he noticed the alteration of the coal bed and the occurrence of a "green ochery mineral" which he sent to the Smithsonian Institute. It was pronounced an unknown uranium mineral, as carnotite had not been described at that time. Captain Berthoud presented a paper on the occurrence before the Philadelphia Academy of Sciences, and the paper was published in the proceedings of the Academy in 1875.[1] In 1916, Dr. Herman Fleck presented a series of papers[2] before the Colorado Scientific Society in which he called attention to the article by Berthoud and gave additional information which he obtained by conversation with the author of that paper. Fleck states that a sample from the occurrence was exhibited at the Centennial Exhibition in Philadelphia in 1876 and that the mineral was determined as carnotite in 1904.

On May 4, 1922, John A. Riley and I were doing stratigraphic research in the region and came upon the yellowish specimens of carnotite on the dump of the old Leyden mine. Tests were made by electroscope and chemical reactions, and the mineral was found to be carnotite. An inquiry revealed that the deposit had been previously described by Berthoud. Study of the geology of Colorado had not progressed far enough to make accurate conclusions on several points possible at that time, and several errors were made on the mode or origin and the age of the formation, which I desire to correct.

The mining of clay and coal has been carried on intermittently in the locality since 1870, and some plastic clay is being mined from beds near the coal seam at present. The locality is owned by the Thomas F. Tucker estate. So far as is known, no attempt has ever been made to work the carnotite, and few are aware of its presence.

The carnotite occurs as yellow incrustations and inclusions in fractured and partially silicified coal. In this locality the formations stand nearly vertical and at some places are slightly overturned. The formation



The carnotite is found in the Leyden coal mine, about 12 miles from Denver

in which the coal seam occurs is the Laramie, regarded as being of Cretaceous age. The fracturing of the coal seam, which allowed the passage of the solutions which caused silicification and deposition of carnotite was probably contemporaneous with the upturning of the strata when the Rocky Mountains were formed. Stratigraphic studies place the age of this uplift near the end of the Middle Eocene or during the late Eocene period.[3] The closely spaced fractures are plainly visible in the silicified coal as vainlets of white quartz through the darker, carbonaceous material. On weathering, the veinlets stand out above the structure in forms similar to weathered septarial concretions.

The solutions, in passing through the fractured coal, filled the fractures with crystalline quartz, in some cases leaving vugs lined with quartz crystals, and, permeating the coal, replaced it to different degrees according to the distance from the larger fractures. A considerable quantity of the coal remains in the silici-

[1] "On the Occurrence of Uranium, Silver, Iron, Etc., in the Tertiary Formations of Colorado Territory." By E. L. Berthoud. *Proceedings* of the Academy of Sciences of Philadelphia, Vol. 27; pp. 363-365.

[2] A Series of Treatises on the Rare Metals. By Dr. Herman Fleck. *Proceedings* of the Colorado Scientific Society, Vol. 11, pp. 103-176.

[3] "The Physical History of the Front Range of Colorado." F. M. Van Tuyl and G. W. Machamer. *Bulletin* Geological Society of America, Vol. 34, 1923.

fied material, ranging from 5 to 50 per cent, according to the degree of silicification.

The carnotite is apparently genetically related to the silicification of the coal, as the quartz in the fractures incloses carnotite and the amount of carnotite is roughly proportional to the degree of silicification as indicated by the silica content.

If the theory that the fractures were filled soon after formation is correct, the age of deposition of the carnotite may be placed as late Tertiary. The silicified coal is cut by fractures of later age, which are filled only where the walls of the fracture are in contact with each other. These post-mineral fractures are probably due to the slight folding that occurred in Miocene and Pliocene time.

Salts Deposited as Laramie Sandstone Was Formed

Berthoud regarded the occurrence as the product of a volcanic "dike," which, entering from below along the bedding plane, replaced and consumed the coal, depositing at the same time an iron-silver-uranium ore. It is apparent, however, that the deposit is the result of silicification by water.

Gow has found that the basalt of the area contains 3.57×10^{-12} grams of radium per gram of basalt, though there is some doubt as to the accuracy of the results. Near the locality no basalt dikes cut the formation, and possible chimneys beneath the Table Mountains several miles to the south would cut the formation more than 1,000 ft. below the elevation of the deposit, so that it could not influence the locality, as artesian circulation since Cretaceous time has been down the dip. In addition, the basalt has little contact effect on the intruded formations. The basalt is not regarded as a source of the uranium salts.

During Quaternary time, and possible even earlier, the exposed edge of the Laramie formation received water from the streams crossing it. These streams erode the mining districts of the Central City and adjoining quadrangles and probably carry some uranium in solution, derived from the ore deposits, many of which contain pitchblende. This possible source of uranium salts cannot be overlooked, but as the Central City deposits were probably covered by Cretaceous sediments during the time deposition was going on, and as the deposit does not extend from the surface downward, but is confined to an area several hundred feet below the outcrop, it is believed that this was not the source of the uranium salts in the carnotite.

The present intermittent stream in Leyden Gulch does not drain any known uranium-bearing areas and has developed since Pleistocene time, so that its waters cannot be regarded as being the source of the uranium salts.

I believe that the uranium salts were deposited in the Laramie sandstone at the time of sedimentation, as the formation was practically cut off from external sources at the time of deposition. In Jurassic time the land masses furnished uranium salts for the carnotite of southwestern Colorado and in late Cretaceous time erosion may have been carrying parts of the same land mass into the Laramie zone of deposition.

The investigations of Coffin and of Lind and Whittemore show that carnotite may be dissolved and redeposited, so that the uranium oxide may exist as such in solution and be precipitated as such. The absence of sulphides accompanying carnotite deposits suggest that reduction of sulphate solutions is not responsible for the deposition of carnotite deposits. The plant practice of some Colorado companies reveals that the carbonaceous ores carry high values into tailing from the plants. This suggests that carbon and carbonaceous material may have a selective absorption effect upon uranium solutions and that the deposition is more of a physical process than a chemical one.

Size and Value of the Deposit

The workings described by Berthoud have long been caved, so that it is impossible to say what tonnage of the silicified coal is present, but from the description given it is probably quite large. He reports 0.2 to 2 per cent uranium in the deposit, which, calculated as U_3O_8, would amount to 0.24 to 2.36 per cent. He also reported 8 oz. of bullion per ton, but assays made on the samples do not show in gold or silver.

The following determinations were made by the emanation method in the radium laboratory of the Colorado School of Mines. The percentage of U_3O_8 is calculated using the factor 3.4 as the radium-uranium ratio.

	Sample	Mg. Radium per Ton	Calculated U_3O_8, Per Cent
1.	Average of carnotite-stained rock from old coal dump	1.35	0.397
2.	Silicified coal from near openings described by Berthoud	0.96	0.282
3.	Unsilicified coal from seam near old workings of Leyden coal mine	0.26	0.076
4.	Picked specimens of carnotite-stained silicified coal	4.42	1.300
5.	Unstained Laramie sandstone	neg.	.....

Sample No. 2 is typical of the deposit. Attention is called to the fact that the ash from the coal will run over 1 mg. of radium per ton.

A study of the deposit and the results of these determinations causes me to conclude that the deposit is not of commercial importance at the present stage of development, and it is doubtful if further development will encounter higher-grade bodies at this locality. However, the deposit demonstrates the presence of carnotite in the Laramie formation and points to this formation as one of the possible carnotite horizons of Colorado.[4]

Mining in California Handicapped

Mining in California during the first half of 1923 was handicapped by lack of efficient labor and by a large labor turnover, according to the U. S. Geological Survey. Considerable development and prospecting work were done during the first six months of the year, particularly in the gold districts. Most of the larger gold mines were run about as in 1922, and a few new gold producers started production. The silver mines worked to full capacity until some curtailment took place in June. The Engels and Walker mines were operated at full capacity, and steps were taken to increase the output at both properties.

Practically all the lead produced in California comes from properties in the southern part of the state, and, though some of these properties were producing, others were equipping or building mills and did not begin production during the first half of the year. No zinc mines were in operation.

The output of both gold and silver during the first half of 1923 did not come up to that in 1922.

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[4]Thanks are due to Prof. L. D. Roberts, of the department of chemistry of the Colorado School of Mines, for accurate determinations of the radioactive contents of samples, to Dr. F. M. Van Tuyl for reading and revision of the manuscript, and to Dr. Herman Fleck for the use of data and papers in his files.

Graphic Appraisal of Mining Property

A Simple Way to Determine Present Worth With the Minimum of Computation

By Alexander B. Morris

THE VALUATION of mining property for any purpose whatever by the analytical appraisal method is usually accompanied by a large amount of computation, involving no little labor in compilation and almost as much to interpret intelligently. The following graphic method avoids both of these difficulties; the first, by making it unnecessary to make any computations until the end of the problem, and the second, by presenting all the elements to the eye in such a way that the influence of each is grasped readily even without knowing the actual quantities indicated.

This method is of particular advantage where the enterprise concerned is subject to the law of diminishing returns, inasmuch as it automatically fixes the economic limit and to a large extent removes that element from the field of conjecture. Its chief limitation is in point of minute accuracy, which is not attainable by its use, since the graph paper can at least be read to only three significant figures. Any errors in reading the paper, however, are so far within the limits of error of the fundamental hypothesis of the problem—the estimate of probable annual production—that they may be disregarded entirely.

It is a property of semi-logarithmic paper that a straight line drawn on it represents a compound discount curve if the slope is negative and a compound interest curve if the slope is positive; in other words, that the ratios between adjacent annual ordinates are constant, depending on the slope. Multiplication and division can be performed on it with the aid of a divider in the same manner that these operations are performed on a slide rule, and a complete problem can thus be worked by running over the sheet a few times with a divider and straight edge.

When a development program has been decided upon, a reasonably accurate estimate can be made of the average annual production in commodity units, such as tons, cubic yards, or barrels, and these values can be plotted on the production curve *A*. The selling price of the product is next to be plotted. If a constant price such as that prevailing at date of valuation is to be used throughout the life of the property, this curve may be omitted, and the gross-receipts curve *B* can be plotted by multiplying each point on curve *A* by the unit price; that is, by means of a divider, increasing or decreasing each ordinate by the distance which each point on the curve *A* is above or below the 10 line. If, however, forecast is made as to the probable trend of the selling price in the future, the selling-price curve must be plotted before the gross receipts curve *B* can be determined. When this has been done, each point on curve *A* is multiplied—using a divider as described above—by the selling price ordinate for the same year, thus giving curve *B*.

Having determined the probable future amount of the gross receipts, the cost of obtaining them (the operating cost) must be estimated. It is customary in many industries to set a fixed cost per commodity unit to be used throughout the life of the property. In my opinion this method, though easy to handle, and though probably not any more dependent upon arbitrary assumptions than that which I shall outline, is extremely misleading and is not in theoretical or practical accord with the conditions as they exist in any operation subject to the law of diminishing returns.

It may be true that a reasonably constant production cost can be maintained in a manufacturing business or in some exceptionally favored mines, but in the vast majority of mining properties, the unit cost is low in the early stages of the operation and increases rapidly toward the point at which it exceeds the selling price, thereby rendering the property worthless unless and until higher prices prevail. For this reason, and because it provides a means of weighing every element entering with production cost, I believe that the property, or the operating unit of plant, should be made the basis of production costs. It is possible to say with greater certainty that an oil lease of forty acres, having nine producing wells, will cost $6,000 per year to operate than it is to say that for the remaining life of the property the average operating cost will be $0.98 per barrel, because it is possible for any engineer with knowledge of the territory to show just how that $6,000 is arrived at; whereas the $0.98 per barrel is a mere guess, or at best an estimate based on uncertain factors. It is as easy to figure the cost of operating a mine or a part of a mine as it is to figure the amount of ore that could be removed in a given period through the existing shafts. The $0.98 per barrel may be correct for this year's business, but it will not be correct for that of next year, and as the output continues to decline the error will continue to increase each year, unless a compensating change in labor and material costs intervenes.

The operating cost per year of the property or any unit, such as lease, well, shaft, level, pit or what not, having been satisfactorily determined in accordance with the prearranged development program, the values should be plotted in curve *C* on the same sheet with curves *A* and *B*. Care should be exercised to place this curve on the paper in such a way that the decimal point will be properly located at the point at which it crosses curve *B*, so that the intersection will not be $3,000 on one curve and $30,000 on the other.

The annual ordinates of each of these curves *B* and *C* represent the actual amounts of money received or expended, respectively, in each year. These are not all received or expended at the valuation date, and both are affected by the operation of compound discount for present worth. The discount rate to be used is open to discussion. Ten per cent has been used in the example. When the rate is decided upon, the straight line corresponding to it should be drawn on the work sheet. This 10 per cent line passes through 1.0 at 0 years and through 0.385 at 10 years. As both curves *B* and *C* are effected by it, each annual ordinate on each curve should be multiplied (using a divider) by the corresponding annual ordinate on the discount curve, giving curves B_1 and C_1 the annual ordinates on which are the present worths, at valuation date, of the annual ordinates of *B* and *C*.

It will be noted that up to this point everything has been done on the graph paper except the establishing of the fundamentals—production quantities and cost. The intersection of *B* and *C* and B_1 and C_1 will fall at the same point of time and indicate the approximate time when operations will cease to be profitable; for in

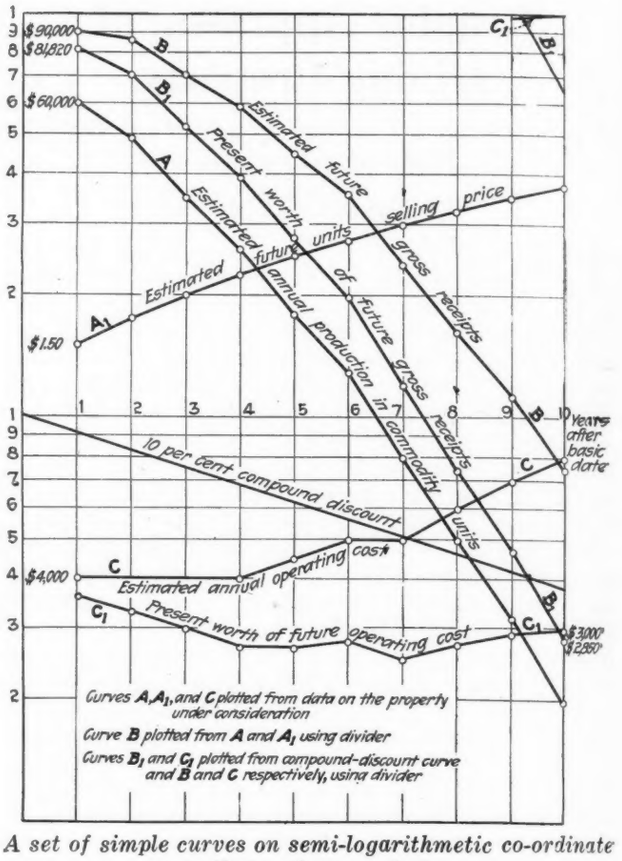
the full year's operations for the ninth year there was a profit of $4,700, whereas on the next full year's operation there would be a loss of $150. The economic limit will always be somewhere to the left of this intersection, generally within five or six months of it, and reasonable accuracy is obtained by cutting off production and profits at the last full year before the actual intersection is reached. The economic limit can be exactly located by a separate interpolation of each curve for the final twelve months by monthly or bimonthly periods if desired, but generally this is an unnecessary refinement.

The total value of the property as at given date—that is, the present worth of all future net profits—is therefore the sum of the differences between the corresponding annual ordinates of curves B_1 and C_1; or, more simply, the difference between the sums of the ordinates of each curve. These may be read, added up, the sums subtracted, and the final result obtained in the only computation required in the entire problem. Only five curves appear on the chart, and the fundamental assumptions upon which these are based can all be examined, discussed and weighed in all their details. Should it be found desirable to alter any one of these, it is not necessary to rework the entire problem. Either curve B or C can be changed without affecting the other, in which case it is merely necessary to replot B_1 and C_1 as the case may be, add its ordinates and use the sum in place of the old one. Or if a different deferment rate is desired, another compound discount line is drawn, corresponding to the new rate, and curves B_1 and C_1 are reconstructed from the unchanged B and C.

The analytical appraisal is useless to determine the "fair market value" of any property as of any given date. The result shows always merely the present worth of the most that a given property may be expected to yield in net profit, and does not reflect in any way the purely speculative elements of market value. With this information in detail laid before him, an operator or capitalist should be able to set his highest or lowest price on the property with reasonable assurance that every element inherent in the property itself has received consideration.

The interpolation to determine the exact time when the enterprise will cease to return a profit (the "economic limit") is an interesting problem in itself, but is useful chiefly in emphasizing some of the properties of semi-logarithmic paper as a medium of graphic expression. It should be borne in mind that the annual ordinates B_1 and C_1 do not show an average rate of return or outgo for the year, but instead the present worth of the total receipts or expenses for the year as if received in one sum; that the slope of the curves represents the rate of decline in value based on *yearly totals*; and that at that annual rate of decline, the portion allocable to January of any year is considerably greater than that allocable to December.

Through the point of intersection of the 10-line with the vertical line corresponding to the end of February of the tenth year (the year in which B_1 and C_1 cross) draw a line parallel to B_1 and one parallel to C_1. Where, as in the present illustration, with line C_1, one of the lines has a rising slope which would throw it into the part of the paper not finely divided, such a line may be passed through the intersection of the 10-line with the vertical line corresponding to the end of December of the final year. Read the factors at the



A set of simple curves on semi-logarithmetic co-ordinate paper that make appraisal easy

bimonthly periods on each, for six bimonthly periods, and add the several factors for each line. Then allocate the tenth year ordinates of B_1 and C_1 by bimonthly periods, the proportion of the corresponding factors to the respective sums as above obtained. Readings on B_1 and C_1 by bimonthly periods are thus obtained, and the earliest period in which the C_1 readings exceed the B_1 reading is the economic limit of the property. The following computation shows this method of interpolation:

	Income B_1	Expense C_1
	1.000	0.982
	.915	.986
	.835	.990
	.770	.994
	.705	.997
	.650	1.000
	4.875	5.949

$\frac{1.000}{4.875} \times 2850 =$	$584	
$\frac{0.982}{5.95} \times 3000 =$	495	
Profit.....	$89	
$\frac{.915}{4.875} \times 2850 =$	$535	
$\frac{.986}{5.95} \times 3000 =$	497	
Profit.....	$38	
$\frac{.835}{4.875} \times 2850 =$	$487	
$\frac{.99}{5.95} \times 3000 =$	500	
Loss.....	$13	

The computation of the theoretical value of the property under the conditions assumed and at the date of

Year	B_1 — C_1 =	B_1—C_1
1	82,820— 3,600 =	78,220
2	71,000— 3,300 =	67,700
3	52,500— 3,000 =	49,500
4	39,500— 2,710 =	36,790
5	28,600— 2,700 =	25,900
6	19,900— 2,800 =	17,100
7	12,000— 2,540 =	9,460
8	7,450— 2,950 =	1,760
9	4,700— 2,940 =	1,760
10	Jan. —Feb. =	89
	March—April =	39
Total value.....		$291,257

calculation may then be made by adding the successive *differences* B_1-C_1, as shown above.

Petroleum Provinces of the United States

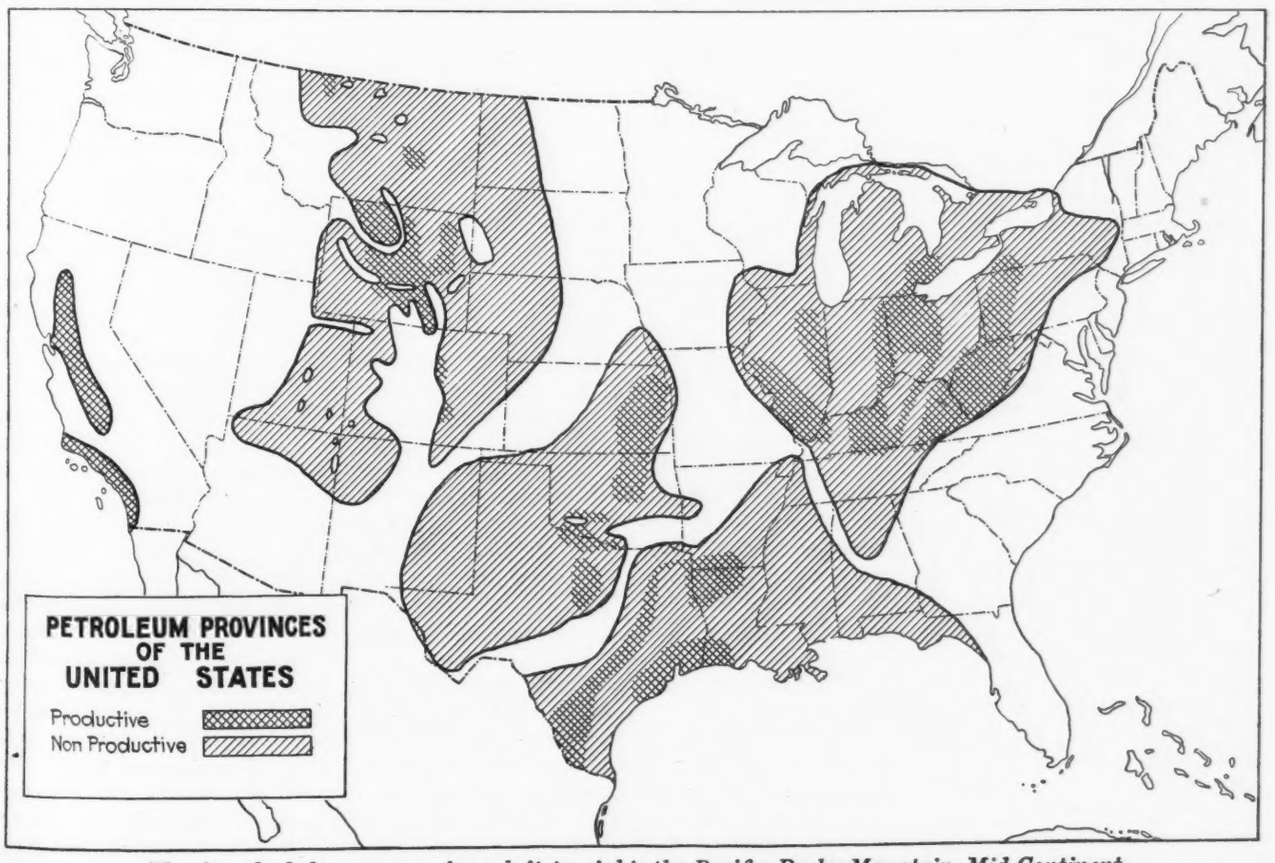
Oil Production Coming From Five Definitely Limited Areas Beyond Borders of Which Prospector May Not Look for Conditions Prevailing Within Them to Extend

By Ernest R. Lilley
Assistant Professor, Department of Geology, New York University

THE TERMINOLOGY used today by the oil man in speaking of the different areas where oil or gas is being produced or in which future production is expected is, to say the least, both confusing and misleading. When the same speaker refers to the Burbank field, the Osage field, the Kansas-Oklahoma field, and the Mid-Continent field in the course of a short conversation one is inclined to wonder what meaning should be attached to the term "field." In the same way the expression "oil district" may be used in several ways. The term "oil pool" has, however, largely escaped misuse, and is today almost universally understood to mean an area in which oil or gas is being secured from a single local structure.

The extent of such structures varies. The salt dome pools of the coastal plains of Texas and Louisiana are usually productive over less than one square mile. On the other hand, Salt Creek, an anticlinal pool in Wyoming, has been proven over more than 25 square miles. If the larger structures be definitely separated by saddles (structurally low areas crossing the axis of the structure) into domes, these are not infrequently spoken of as individual pools, but in general the term is reserved for the complete unit, as the saddles are frequently productive in at least one horizon.

In Wyoming and in the Gulf section the producing pools are completely isolated one from the other by areas apparently barren of oil or gas. In other places, such as Pennsylvania, West Virginia, Kansas, and Oklahoma, the individual pool, though sometimes clearly defined, is frequently almost impossible to isolate. In Creek County, Okla., producing wells are found in nearly every square mile. By this statement I do not wish to give the impression that all the wells drilled have been commercial producers, but to indicate that limits of the producing areas are by no means definite and that no distinct line can be drawn to separate productive from unproductive territory. This is largely due to the nature of the productive horizons. Lenticularity in oil sands may make possible the drilling of dry holes on the crests of promising folds and good wells in areas where they are least expected. Furthermore, the section which yields the best wells in one sand may be wholly unproductive in another. In opening up such areas the term "pool" is commonly used in referring to the isolated groups of wells first drilled, but as the



The five shaded areas are, from left to right, the Pacific, Rocky Mountain, Mid-Continent, Gulf, and Eastern provinces

area between them becomes dotted with wells the term loses much of its significance. These later wells may be drilled to different depths or they may prove to be of such size that they cannot be pumped at a profit during the early history of the section. In the first instance, there may be no relation between the wells first drilled and those completed later, and, in the second, wells may be abandoned and the locations redrilled years after.

Economic Bonds a Basis for Classification

Such areas do have, however, distinct economic bonds holding them together. A common railroad center through which the operators secure their supplies and equipment or a town used by supply houses as the site of field warehouses tends to bring a certain unity to operations during development. To such sections the term "district" may well be applied. Thus, in Pennsylvania will be found the Bradford district, and in Oklahoma the Okmulgee and the Bristow districts as representative of a score of others. Where the grade of the oil is practically the same, the term may be extended by the usage of the pipe line or purchasing company to include a much larger area. The typical district does not of necessity include only areas producing one grade of oil, as in many leases several distinct types are recovered from different sands.

When the area referred to includes several hundreds or even thousands of square miles, the bulk of which may be still undeveloped, the basis of classification must depend upon factors less easily defined. In common usage the term "field" is used without discrimination in referring to any large producing area. Thus the names Mid-Continent field, California field, and Rocky Mountain field cover distinct producing and prospective areas. However, the oil man also speaks of the North Texas field, the Valley field, and the Big Horn Basin field, which are subdivisions of the first group mentioned. To clarify the situation I have for some time been using the term "province" for the larger divisions and restricting the term "field" to the smaller. In defining a field I would call it an area in which one major structural feature is dominant, such as a regional syncline, a broad anticlinal arch, or a monocline. In cases where beds of different ages are productive in entirely different parts of a monocline of major extent, the term may be used to separate these also.

For example, the numerous pools and districts of western New York, Pennsylvania, southeastern Ohio, West Virginia, and eastern Kentucky have been caused by local folding, faulting, or variation in nature of the containing beds on a large westward-dipping monocline sloping away from the old Appalachian Paleozoic land mass. Similarly, the producing areas of northeastern Oklahoma and Kansas lie upon a monoclinal slope extending westward from the Ozarks. In both cases local conditions determine the success of wells drilled. To these I would give the names Appalachian field and North Mid-Continent or Ozark field.

Where the monoclinal slope is wide and two areas completely isolated from each other are developed in different horizons, as is the case in the southward dipping monocline of Texas, Louisiana, and southern Arkansas, where Cretaceous beds are productive to the north and the Tertiary beds in the south, the names Stratum field and Coastal Dome field seem best.

Anticlinal arches are not common in the areas developed up to the present. Probably the best example of the broad arch yielding oil from local structures is the Cincinnati arch, known the world over because of the enormous yield secured in the Lima-Indiana district. Arches are, like the monoclinal fields, productive only in spots where conditions are locally favorable.

In Wyoming, the producing pools group themselves into fields of the synclinal type separated from one another by mountain ranges composed largely of older and non-productive rocks, such as the Big Horn Basin, the Wind River Basin, and the Powder River Basin fields. The various pools are found mainly on the flanks of these basins, which are both topographical and geological units. Their size does not permit the development of broad monoclinal slopes nor of major anticlinal arches. Subdivisions other than into units of the district or pool type are therefore unnecessary from a geological viewpoint, and likely to prove ludicrous from a commercial one. To such synclines, which are neither local nor continental in extent, I have applied a new term, "regional syncline." It should not be confused with the geosyncline, which is continental in proportions and will be referred to later. As examples of fields outside of the Rocky Mountain section which fall into this group might be mentioned the San Joaquin Valley and Coastal fields of California, the Maracaibo field of Venezuela, and the Burma field of India.

Five Prominent Areas in Country Today

East of the Rocky Mountains ten fields hold prominent positions in the oil industry today. These are not totally unrelated to one another, but group themselves in definite ways in three major units or provinces, which we may call the Eastern, the Mid-Continent, and the Gulf provinces. In the same way the fields of the West may be placed in two provinces, the Pacific and the Rocky Mountain.

Of the five areas mentioned, the Eastern is naturally the one most developed and in consequence the easiest to discuss. As one goes from east to west from the pre-Paleozoic cores of the Appalachian ridges one passes through in rapid succession four distinct fields: the westward-dipping monoclinal Appalachian field; the Cincinnati arch, with its axis approximately north and south; the narrow La Salle anticlinal field of eastern Illinois; and a group of isolated pools of minor importance in southwestern Illinois on the eastward-dipping slopes from the poorly defined Ozark mass. The productive horizons, though not continuous throughout the whole area, are closely related, and at no place can their continuity be said to be broken completely. If one of these fails to extend from one field to another, the continuity of the whole is, nevertheless, maintained, if other beds can be found extending through both.

Between the area occupied by the four fields and the rest of the producing sections of the country there are, however, distinct barriers. To the north of the area, which is roughly shaped like the letter V, lies the pre-Cambrian Canadian field; to the east and southeast the old rocks of the Paleozoic land mass Appalachia; and to the west the Ozarks, a section emergent during most of the Paleozoic era. Except in the northwest, where some of the sediments extend beyond the confines of the basin formed by these masses, and in the southwest, where the record is hidden by a covering of younger deposits, this area of Paleozoic oil-bearing beds is completely surrounded by territory in which drilling would be equivalent to throwing away money.

To such wide areas as this I would apply the term

"oil provinces." In development and extent they are essentially the same as the geosynclines of the historical geologist, except that their area is not necessarily limited, as is the geosyncline, to the areas of excessive depression and rapid deposition, by some writers. Thus the Appalachian geosyncline is generally understood to include only a narrow area of deposition west of Appalachia, in spite of the fact that the waters of the basin were continuous as far west as the Ozark land and sediments were being laid down at the same time throughout the whole area. On the other hand, such broad basins may not be oil-bearing throughout, for though on one side the climatic conditions may be most suited to the growth of oil-source life, those prevailing on the other side may be distinctly unfavorable. Furthermore, usage of the term has limited the geosyncline to an area occupied by an epeiric sea rather than that of the marginal epicontinental sea.

In the example cited, the period of deposition of oil-bearing sediments was limited to the Paleozoic era and seems to have reached its height in the middle of the era. In other provinces the deposition has not begun until the early part of the Tertiary, and in one deposition occurred intermittently from the late Paleozoic to the early Tertiary. In general, the older the province the greater is its distance from the seas of today. Thus the provinces formed during the Paleozoic include the Mid-Continent, whereas among the Tertiary would be listed the Pacific.

The Mid-Continent basin, though not fully uncovered, seems to have had a general southwest to northeast direction and to have occupied the trough between the Paleozoic Rockies on the west and the Ozarks and the Llano mass on the east and southeast. Dividing it into two sub-basins, which, however, remained connected, was a series of east-west ridges occupying the same section as is now taken by the Wichita, Arbuckle, and Quachita mountains. Within the larger basin four fields are now developed in part. The first of these, the north Mid-Continent or Ozark west slope field, is the most important. To the north of the Wichitas lies a field which is largely undeveloped, but the south slope field is well known as the source of the production of southern Oklahoma and North Texas. Producing from beds dipping north and northwest from the Llano section of Texas and immediately south of this field is the north-central Texas field. No commercial production has been secured from the southwest or western portions of the major basin, which are largely covered by great thicknesses of beds barren of petroleum.

The province is entirely distinct from the Gulf province, whose northern boundary is formed by the Llano and Quachita masses and whose producing beds were not laid down until periods much later than those of its neighbor. The Gulf basin seems to have developed during early Comanchean time, and though varying in size and form to have maintained itself ever since. In sections where sediments, deposited during periods when its waters covered what are now coastal plains, are again above the level of the Gulf, four distinct fields have been discovered: the Stratum and the Dome fields of the southward-sloping monocline of Texas, southern Arkansas and Louisiana, the Tampico-Tuxpam area of eastern Mexico, and the Tehuantepec-Tabasco field of southern Mexico.

The Rocky Mountain province contains beds which were formed during widely separated periods in the earth's history, some as recent as the Tertiary, others in the late Paleozoic. Many of its structural subdivisions were fully outlined before the period during which the most important beds, from the viewpoint of the oil man, were laid down—that is before the Cretaceous. As a result, the great epeiric sea which in that period extended from northern New Mexico to Yukon Territory, and from western Kansas to eastern Utah, must have been in many places a series of connected seas rather than one large sea. In these small basins whose development seems to have been greatest in Wyoming, where the sea straddled the older ridges of the Rockies, the conditions appear to have been much more favorable to the formation of oil-bearing sediments than in the broad open waters to the north and east. Already numerous pools have been located on the flanks of these regional synclines, the most productive of which are the Big Horn and the Powder River basins.

The Pacific epicontinental shelf province contains only two fields in the United States, both producing from Tertiary beds. These, though capable of further extension, do not appear to be forerunners of others of the same type along the Pacific coast of the United States, although fields may be discovered in Alaska and Mexico. These two, the Valley and the Coastal fields, are, though productive from the same general horizons and closely related geographically, separated by a strip of non-productive territory.

Conclusions

In this article I have made no attempt to indicate the areas in which prospecting might be attempted with the greatest chance of success. Before such suggestions can be offered in any new region its general geology must be fully understood. The drilling of test wells on local structures five or six miles from a producing pool is a good business proposition, but the drilling of such wells hundreds of miles from any successful tests or in places which lie between two provinces or fields merely because the structure "looked good" involves a chance altogether too great.

When tests in foreign fields may run over $100,000 per well it would seem worth while to spend some money in finding out what relation the beds in the area which it is planned to test bear to the seepages or producing wells within a radius of as much as a thousand miles. Yet the area between the Maracaibo field and the seepages of the northern Orinoco basin is being eagerly sought by concessionaires, though geologically it is entirely distinct from them and contains none of their oil-bearing beds, and the economist and feature writer extends the Persian Gulf field northward to Baku. Even in our own country prominent trained geologists indicate no break between two such distinct sections as the Stratum field and the north central Texas division of the Mid-Continent in a recently published map.

The oil province is a definite limited area beyond the borders of which the prospector must not expect conditions prevailing within it to extend. The borders may not be the same for all horizons, as local fluctuations may bring differences during the long period of its formation, but its general synclinal outline is maintained throughout the whole area. Within the province further limits may be placed upon the areas suitable for testing, because of lack of porous containers and suitable structures or because of excessive carbonization.

Recent Technical Publications

Reviews, Abstracts, and References

Michigan Mining Industry—"Production and Value of Mineral Products in Michigan for 1921 and Prior Years" has recently been issued as 138-page book by the Geological Survey Division, Department of Conservation, Lansing, Mich. The book gives detailed information regarding production and costs of the various Michigan copper companies, production and a list of the operating iron companies, and data on the nonmetallic mineral industry of the state.

Canadian Mining—The summary report of investigations made by Canadian Department of Mines, Mines Branch, during 1921 has been published as Bulletin 586, pp. 346, obtainable on request to the branch at Ottawa, Ont. The most important chapters include: Alkali Deposits of Western Canada; Oil Shales of Canada; The Low-Grade Copper Ores of Hidden Creek, Anyox, B. C.; The Flin Flon Complex Sulphide Ore; The Concentration of Graphite from the North American Mine; The Concentration and Separation of the Minerals in the Lead-Zinc-Silver Ores of Kimberley, B. C.; The Milling of Asbestos Rock; The Concentration of the Lower-Grade Copper-Nickel Ores; and The Concentration of Garnet from Its Rock.

Petroleum Bibliography—Bulletin 216 of the U. S. Bureau of Mines, Washington, D. C., pp. 374, obtainable on request from the Bureau, is a "Bibliography of Petroleum and Allied Substances in 1919 and 1920." The bulletin is similar to those that have been published previously for preceding years, listing all articles published in domestic and foreign papers, with a few words descriptive of the scope of each.

Government Co-operation in Mining—Bulletin 160 of the Mining and Metallurgical Society of America, 115 Broadway, New York City, reports a discussion to which a recent meeting of the society was devoted, on the subject of how far the government and public institutions should go in assisting operating mining companies to improve their practice.

Minerals of California — A fourth bulletin on the minerals of California has been prepared, this being an enlargement of that issued in 1914 as Bulletin 67 of the California State Mining Bureau. The book is a bound volume of over 300 pages giving brief descriptions of the minerals that have been found in the state, their properties, and detection. The record of occurrences is very detailed, being arranged by counties, and should be of considerable help to prospectors and mineralogists working in the state. Many helpful analyses are also given. The compilation has been made by Prof. Arthur S. Eakle, so should be authoritative. Copies of the book may be obtained from the State Mining Bureau, Ferry Bldg., San Francisco, Calif.

Mineral Resources—Recently issued separates of the "Mineral Resources" series include "Zinc in 1922," pp.16; "Peat in 1922," pp. 2; "Lead in 1922," pp. 10; "Bismuth, Selenium, and Tellurium in 1922," pp. 11; and "Asphalt and Related Bitumens in 1922," pp.7. These pamphlets may be obtained on request from the U. S. Geological Survey, Washington, D. C. The bound volume containing all the chapters on the metals for 1920 has also recently been published.

Mining in the Far East—Special Agents Series No. 218 of the U. S. Department of Commerce, is a 411-page illustrated commercial and industrial handbook of the Netherlands, East Indies and British Malaya. It is obtainable from the Superintendent of Documents, Washington, D. C. for $1. The book contains a 26-page chapter on mineral products and hydraulic power, largely a discussion of tin mining in British Malaya, and a chapter on the iron and steel trade of that section of the world.

New Zealand Geology—"The Geology and Mineral Resources of the Collingwood Subdivision, Karamea Division," is the subject of Bulletin No. 25 of the Geological Survey, Wellington, New Zealand (price, 6s. 3d.) The bulletin is of 52 pages and is illustrated with colored maps, photographs, and sketches. The district has several small coal fields, but the marble deposits seem to be of the greatest potential importance.

Fatigue of Metals—The Engineering Foundation has published its annual report for the year ended Feb. 8, 1923. (Engineering Societies Building, 29 West 39th St., New York City.) Sixty pages of the report are devoted to the results of an investigation of the fatigue of metals. There are also brief papers on "Internal Stresses in Metals" and the "Graphitic Corrosion of Cast Iron."

Fuel Economy—"Some Practical Aspects of Fuel Economy" are mentioned in Publication 2,715 of the Smithsonian Institution, Washington, D. C., 19 pages, obtainable on request. The importance and methods of analyzing flue gases are brought out, to the end that expensive coal may be burned with the greatest efficiency. The printer has neglected the last step in efficient production—viz., the cutting of the pages.

Australian Yearbook — The official yearbook of the Commonwealth of Australia for 1922 has been received. It contains the customary record, occupying over 1,000 pages, of Australian affairs for the year under review. The chapter devoted to mines and mining takes up fifty pages. Copies may be obtained from the Commonwealth Bureau of Census and Statistics, Melbourne.

Coloring of Metals—In *Chemistry and Industry* for July 13 (Central House, 46 and 47, Finsbury Square, London, E. C. 2; price 1s. 9d.) is a 4-page paper summarizing four processes used for coloring iron and copper work invented by Rondelli and Sestini, in which no reagents containing metallic salts are employed. Three of the four processes are electrolytic, the articles being submitted to anodic oxidation in a bath of strong caustic alkali; in what is known as the "shiny black oxidizing process, no electric current is used, oxidation being effected by an alkaline bath containing an oxide of a metal electronegative to iron, so as to produce oxidation of the iron surface with separation of the metal of the oxide used.

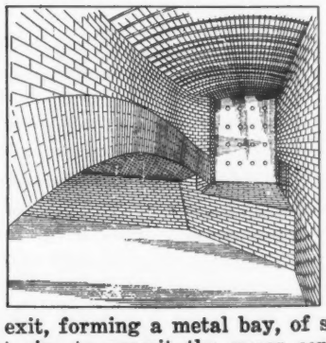
Patents

Metallurgy of Zirconium—No. 1,454,565. May 8, 1923. Otto Ruff, Breslau, Germany. Zirconium ores are heated strongly with a carbonate of an alkali metal in stated proportions, and afterward the water-insoluble zirconium compounds are dissolved in an acid.

Mine Car Wheel—No. 1,454,640. May 8, 1923. F. W. Henrikson, Mulberry, Kansas. A design for a mine car wheel with locking slots on the spokes to engage the hub cap.

Flotation Machine — No. 1,454,656. May 8, 1923. C. E. Rork and August Sandberg, Douglas, Ariz., assignors to W. A. Butchart, Denver, Colo. An improvement in the design of the mechanically agitated flotation machine having the agitating device mounted on a horizontal shaft, as in previous models.

Reverberatory Furnace — No. 1,454,024. May 1, 1923. A. N. Jette, Anaconda, Mont. A reverberatory furnace equipped with a secondary chamber at



the exit, forming a metal bay, of sufficient size to permit the gases coming from the furnace to expand. A damper is provided in the exit flue. The design is shown in the accompanying illustration.

Drier—No. 1,453,750. May 1, 1923. N. C. Christensen, Salt Lake City, Utah. A one-hearth drier, with means for spreading the material out on the hearth, discharging it therefrom, introducing heated gases into the chamber, and removing the dried product from the conical bottom of the containing chamber.

Societies, Addresses and Reports

Further Details of A.I.M.E. Program for Canadian Trip Announced

Many Interesting Points Will Be Visited In Ontario and Quebec During Fall Meeting

The following program has been announced by the A.I.M.E. for the technical sessions that are to be held at the Mount Royal Hotel, at Montreal, Aug. 30, following the extended visit to the various camps of Ontario and Quebec:

Mining and Milling Session
John A. Dresser, Chairman.

"Contribution to the Kick vs. Rittinger Dispute." By H. E. T. Haultain.

"New Slow Motion Pictures of Ball Paths in Tube-mills, and Rock Crushing in Rolls." By H. E. T. Haultain and F. C. Dyer.

"Proposed Plan for Crushing, Grinding, Grinding, and Concentrating Low-grade Sulphide Copper Ore." By Arthur Crowfoot. Lantern slides.

"Mining Methods at the Bawdwin Mine, Burmas." By A. B. Calhoun. Lantern slides.

"Emergency Power for Mines." By Graham Bright.

"Loading Ore Underground with Scrapers at the Utah-Apex Mine." By S. P. Holt.

Geology Session
Dr. W. G. Miller, Chairman

"Helium, a National Asset." By Richard B. Moore.

"Cherts and Igneous Rocks of the Santa Elena Oil Field, Ecuador." By Joseph H. Sinclair and Charles P. Berkey.

"Practical Results Obtained by Schlumberger Method of Electrical Prospecting." By Sherwin F. Kelly.

"Magnesite Deposits of Grenville, Quebec." By G. W. Bain.

"Secondary Enrichment at Eagle Mine, Bonanza, Colo." By C. Erb Wuensch.

"Porcupine Ore Deposits." By Louis D. Huntoon.

Iron and Steel
J. V. W. Reynders, Chairman

"X-ray Examination of Irregular Metal Objects." By Ancel St. John.

"X-ray Examination of Steel Castings." By H. H. Lester.

"Nitrogen in Steel." By C. Baldwin Sawyer.

"Desulphurizing Power of Iron-Blast-furnace Slags." By Richard S. McCaffery and Joseph F. Oesterle.

"Effect of Silicon on Equilibrium Diagram of System Carbon-iron, near the Eutectoid Points." By H. A. Schwartz, H. R. Payne and A. F. Gorton.

"Some Commercial Alloys of Iron, Chromium, and Carbon in the Higher Chromium Ranges." By C. E. MacQuigg.

"Some Effects of Zirconium in Steel." By Alexander L. Feild.

"Selecting Material for Formed and Drawn Parts." By L. N. Brown.

The entire meeting will last from Aug. 20 to 31. Details of the program have already been announced. The start will be made at Toronto where members and their guests will register at the Parliament Buildings in the Entrance Hall. During the day members will be the guests of the City of Toronto and of Toronto mining men. In the evening, films of mining operations in northern Ontario will probably be shown. The following day will be spent at Sudbury, where visits will be made to the Creighton mine, the smelter of the Mond Nickel Co. at Coniston, the smelter of the International Nickel Co., at Copper Cliff, as well as the plant of the British America Nickel Corporation. Wednesday and Thursday will be spent at Cobalt. In the morning the mills of Coniagas, the Mining Corporation of Canada, and of the Nipissing and O'Brien companies will be visited. In the afternoon there will be an opportunity to study the underground and surface geology or to inspect the hydraulic compressors at Ragged Chutes, or else the pleasant alternative of motor trips and golf. In the evening, there will be papers on geology, mining and smelting. On Thursday the mines at South Lorrain will be visited. Those desiring it will have the opportunity to take a boat trip on Lake Temiskaming.

From Cobalt the party will proceed to Kirkland Lake on Friday, Aug. 24. After breakfast in the dining car the members will be taken to Lyric Theatre where a short talk on the more important geological features will be given by Percy Hopkins. The party will then be divided into sections and be taken to the following mines: Kirkland Lake, Teck Hughes, Lake Shore, Wright-Hargreaves, and Tough Oakes. At noon a buffet luncheon will be served at the different mines. Entertainment will be provided in the evening.

On Saturday morning, Aug. 25, the pulp mill of the Abitibi Power & Paper Co. at Iroquois Falls will be visited. After this the party will take its train again and proceed to the Porcupine district. At South Porcupine the plant of Dome Mines, Ltd. will be inspected. The Hollinger at Timmins, and the McIntyre-Porcupine Mines at Schumacher will be visited likewise. In the evening entertainment will be provided by the mining men and ladies of the district. The following day will also be spent at Porcupine with a continuation of visits to the various mines. In the afternoon the party will leave by its special train for Quebec where it will arrive early in the evening.

Various sight-seeing trips will be arranged in Quebec city. These include a drive out to Cap Rouge, to Quebec Bridge, to Montgomery Falls, then on to Ste. Anne de Beaupré. There will be no program for the evening. But the special train will leave about midnight for the Thetford asbestos mines.

The mines and dressing plant will be inspected on the morning of Wednesday, Aug. 29. In the afternoon the party will leave by its special train for Montreal arriving there at the Mount Royal Hotel in the evening. The papers to be presented at the technical sessions at Montreal on Aug. 30 have already been stated. In the evening the formal banquet will be held at the hotel.

On the following day, the final day of the trip, various sight seeing excursions have been suggested by the committee, which will conclude the program.

Mining Congress Will Discuss Standardization Again

Standardization will again be a important topic of the conferences to be held at the convention of the American Mining Congress at Milwaukee on Sept. 26, 27 and 28. The program of the National Standardization Conference on this occasion will be featured by several addresses. Secretary of Commerce Hoover has been asked to speak. Other speakers will be Albert W. Whitney, chairman of the American Engineering Standards Committee; Charles A. Mitke, chairman of the metal mining branch of the standardization division of the Mining Congress; and Col. W. R. Roberts, chairman of the coal mining branch. In the afternoon, the various committees will make their reports. These include the committee on drilling machines and drill steel; underground power transmission and power equipment; mining and loading equipment; mine timbering; metal mine accounting; underground transportation; and mine ventilation.

On the following day there will be a continuation of these committee reports, which will include the reports on milling and smelting practices; fire fighting equipment; mine drainage; methods of mine sampling; mining excavating equipment; and mechanical loading underground.

First Aid and Mine Rescue Meet for Salt Lake City

Plans for the entertainment of the first-aid and mine rescue teams and others coming to Salt Lake City for the International Meet to be held there Aug. 27, 28 and 29, are going forward under the auspices of the Chamber of Commerce, American Mining Congress and other organizations. Twenty or more teams and several hundred men will compete for medals and prizes. The members of the teams and visitors will be entertained by trips to Saltair, to Warm Springs baths and other places, taking place after the contests. On Wednesday evening, the last evening, there will be a banquet.

Especial committees have been appointed to look after the visitors, as follows: Bureau of Mines Committee, J. D. Parker, chairman; Executive Committee, W. Mont Ferry, general chairman; Committee on Arrangements, A. G. Mackenzie, chairman; Reception and Hotel, Will Browne; Publicity, Gail Martin; and Finance, F. B. Cook, chairman and treasurer.

MEN YOU SHOULD KNOW ABOUT

Albert Burch was recently at Iron Mountain, Shasta County, Calif.

Ira B. Joralemon, mining geologist, has returned to San Francisco.

F. Sommer Schmidt has spent the last three weeks at Butte, Mont., on professional business.

R. M. Raymond, professor of mining engineering, School of Mines, Columbia University, is in San Francisco.

F. E. Calkins, of Globe, Ariz., has recently completed the examination of several mines at Randsburg, Calif.

R. C. Nowland, field engineer for D. C. Jackling, recently left San Francisco to be gone a month or more.

George H. Carnahan will spend August in Mexico, and expects to return to New York early in September.

Roy K. Brown has succeeded **Harry D. Moore** as superintendent of the Rescue-Eula Mining Co., operating at Tonopah, Nev.

Edward L. Stenger has been appointed chief engineer for the West End Consolidated Mining Co. at Tonopah, Nev.

E. H. Wells, president of the New Mexico School of Mines, at Socorro, has returned from a month's vacation at Santa Rita, N. M.

Walter L. Reid, metallurgical engineer for the Metals Exploration Company, is at the United Comstock for an indefinite period.

Thomas Riggs, vice-president of the Continental Mines, has made an inspection of the company's properties in Cobalt and Kirkland Lake.

C. E. Crossley, representing an English corporation, is examining and sampling a number of old mines in the Ymir district of British Columbia.

Stanley Graham, of Kingston, field representative of J. B. Tyrrell, of Toronto, has completed an examination of the Detroit-Goudreau property.

J. A. Ede, consulting mining engineer, LaSalle, Ill., has returned from an investigation of the Hecla and adjoining properties in Lawrence County, Ohio.

F. C. Ninnis, mill superintendent for the West End Consolidated Mining Co. at Tonopah, has returned to Tonopah from a business trip to San Francisco.

Dr. John R. Reeves has completed an examination of the oil-shale deposits in the Grand Valley, Colorado, district and has returned to Bloomington, Ind.

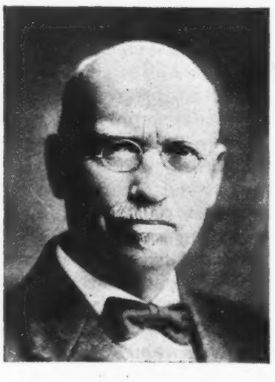
W. D. O'Brien, mining engineer of Santiago, Chile, is in San Francisco. He will leave for London and return to Chile via New York in the near future.

General Frank Maloney, of Knoxville, Tenn., and Washington, D. C., and Kirby Thomas, New York, have been elected directors of the Goldfield Florence Mining Co. of Goldfield.

Charles McCrea, member of the Ottawa-Ontario Government, was recently appointed Minister of Mines for the province. Mr. McCrea is a lawyer who has lived most of his life in the Sudbury nickel district, and, in addition to having an extensive knowledge of the mining industry and its requirements is interested in several mining ventures. Mr. McCrea's appointment will meet with the hearty approval of the mining industry of Ontario.

Charles McCrea

Dr. J. A. Udden, director of the University of Texas, with a chief geologist, two assistant geologists and three laboratory assistants, is conducting systematic examination of samples from deep bores in that state, by means of special methods. Dr. Udden's research was responsible for the identification of potash beds in Texas as long ago as 1914, as noted on page 221 of this issue.



Dr. J. A. Udden

Le Roy Gross, mining engineer of New York, has recently examined mining property in the Portland Canal district and is now at Wrangell, Alaska.

Edward Copperthwaite, of London, England, representing important British mining interests, is visiting the Porcupine and Kirkland Lake mining districts.

W. E. Thorn, placer mining engineer, is in San Francisco. He will return to Medellin, Colombia, South America, after completing an examination in British Columbia.

E. C. Simpson, who has been superintendent of the MacNamara and MacNamara Crescent mining companies for several years, has resigned his position to devote his time to personal interests on the coast.

F. J. Kipp and **Carl Landsee,** of Milwaukee, Wis., directors of the Hecla Mining Co., attended the meeting of directors at Wallace, Idaho, on July 17, following the fire that destroyed the surface plant at the mine.

John Taylor, of the mining engineering firm of John Taylor & Sons, London, England, is on his way to the Kirkland Lake gold district, where the firm has secured extensive interests and is planning an expenditure of $1,000,000.

H. S. Munroe was elected a vice-president of the Granby Consolidated Mining, Smelting & Power Co., Ltd., on July 24. He has been general manager of the company for the last three years and is located at Anyox, British Columbia.

R. D. Caples, assistant general superintendent of the Anaconda reduction works at Great Falls, and **L. R. Margetts,** superintendent of the Washoe smelter at Anaconda, are spending a few days in Wallace and other places in the Coeur d'Alene district.

Frank H. Armstrong, Vulcan, Mich., inventor of the well-known "Armstrong Shuveloder," and for many years master mechanic at the mines of the Penn Iron Co. has resigned from his position, and accepted one with the Lawton Engineering Co., of De Pere, Wis.

F. H. Keefer, has been appointed to the newly created office of under secretary to the Department of Mines, Lands, and Forests of Ontario, with instructions to study the needs of northern Ontario for the information of the government.

Samuel L. Silverman, of New York, principal owner of the Forty-nine group of claims in the Salmon River district, is at Stewart, B. C., to meet representatives of English interests that have the property under bond.

Roy Hollman has been selected for the position of geologist in charge of the Minerals Division of the Louisiana Department of Conservation. Mr. Hollman for several years has been engaged in oil geological work in the Mid-continental and Gulf Coast regions.

Malcolm Stobie, of Stobie & Forlong, Toronto brokers; **Judge F. H. Phippen,** of Toronto; and **W. D. Wilson,** of Hamilton, accompanied by **R. B. Lamb,** of New York, who will act as advising engineer to the party, are in the Salmon River district of British Columbia.

THE MINING NEWS

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Leading Events

PLAN for Calumet & Hecla copper merger agreed upon by the interested participating companies.

Idaho's platinum bubble bursts.

Sulphate plant at Durango, Col., making progress.

Calumet & Arizona not to merge with other producers.

Admission of skilled foreign miners in northern Michigan copper camps is urged.

Lake iron ore shipments are heavy this season.

Future of American radium industry dark.

Kirkland Lake makes a record production.

United Verde Extension explains taxation suit.

Gold rush to McNeil township, Quebec, reported.

Labor shortage acute in California.

Verde Central explorations look good.

Leadville Deep Mines drainage project progressing.

Calumet & Arizona Not to Merge With Other Producers

Has Nothing to Gain by Doing So—Good Outlook for the Future

The report that the Calumet & Arizona Mining Co., in the Bisbee district, would merge with other copper producers in the Southwest is denied by Gordon R. Campbell, Calumet, Mich., president.

Discussing the reported merger, George A. Newett, of Ishpeming, Mich., a director of Calumet & Arizona, says:

"Calumet & Arizona belongs in the list of moderate-cost producers and could not hope for any betterment of position by joining with any group whose costs would exceed its general level. The company has always made creditable progress, has been excellently managed and has a bright future. It still has a large acreage to be explored which should yield important new mineral values. It possesses in its New Cornelia Copper Co. holdings a valuable asset that will be available for thirty years on the present developed lands, the present estimates will undoubtedly be much exceeded in years to come as more time has been had in which to explore lands now held by the company that are well located with reference to the mineralized area in the Ajo camp. New Cornelia is now being equipped to treat its sulphide ores, constructing a plant that will be the finest in this line to be found the world over. It is now better than 60 per cent finished and probably will be ready for ore treatment next October. The company soon thereafter could double its present metal output if the market warranted, as it then can produce copper from both its carbonate and sulphide orebodies.

"Calumet & Arizona is prospecting the Verde Central property in the Jerome camp, and is encouraged by what it is now finding there. Should a mine result it would be a fine addition for the company and beneficial to its many shareholders. The company is in the business to remain, and for this reason does not care to join with any other organization."

Urges Admission of Skilled Miners to Michigan Copper District

R. H. Brondyke, chief of the immigration department at Sault Ste. Marie, Mich., is recommending to immigration authorities at Washington that 500 skilled miners from European countries be permitted to come through that port to be employed in the Calumet & Hecla and other copper mines in the Michigan district.

Before making the recommendation, Mr. Brondyke visited the copper and iron districts of Michigan and made a personal survey of the labor situation. "The situation is acute," he said upon his return from the copper region. "There are many vacant houses in and near Calumet. I was told that the mines have been running short handed for the last eighteen months. I am convinced that the situation is acute not alone in Calumet but in all other mining centers in the Upper Peninsula of Michigan."

Mr. Brondyke interviewed many of the miners and learned that working and living conditions were most satisfactory. Fine, modern eight-room houses rent for $8 per month, and others can be obtained for as low as $5 and $6 per month, the rate being $1 per room. The wages average about $5 per day for an eight-hour day.

The need for labor is imperative and must be met if the mines are to continue to operate at a profit.

U. V. X. Explains Its Taxation Suit

Company Says It Is Not to Start a Mine-Tax War

James S. Douglas, president of the United Verde Extension Mining Co., has set forth the position of his company regarding a recent suit that had been instituted against the Arizona State Tax Commission attacking methods of assessment, in a letter directed to Governor Hunt. In the action referred to, the company had contended that its holdings were over-assessed and that the valuation of $27,422,422 was $7,422,422 more than the cash value of the properties and that the value of the mining properties at Jerome, the smelter at Clarkdale and the railroad was not in excess of $20,000,000. The company refused to pay taxes on any assessment in excess of that amount and tendered the county treasurer a check based on that valuation only. The county officials then sought to place the company's property on the delinquent list, but were restrained from doing so by an injunction which provided that the United Verde Extension should give bond for $100,000 with the condition that any additional taxes that the court decided to be due would be paid. Criticism of the litigation that was begun by the company and attack on the fact that relief was sought in the federal court precipitated the statements contained in the letter written by Mr. Douglas to the Governor.

The president pointed out that the only recourse for his company to seek an adjustment of an unfair assessment would have been to appeal to the board of equalization, which consisted of the same member of the tax commission that had fixed the valuation, and that under such circumstances a readjustment was not likely to be secured. The appeal to the federal court was resorted

to, he said, because the Inspiration company had previously failed to secure relief by an appeal to the state courts, the supreme courts holding that the laws do not permit an appeal to the courts of Arizona from an assessment by the Tax Commission, but only where the assessment was made by the county authorities. Irregularities in the application of the "five-year plan," whereby the valuation of mining properties is based on earnings over the preceding five years, was also charged by Mr. Douglas, stating that the plan had been adhered to only as long as the bonanza profits of 1915 and 1916 were included. He also stated that it was not the intention of the United Verde Extension to start a mine tax rate war and that it was regretted that no other way than costly litigation was available, but that it was the aim of his company to attain a fair assessed valuation based on the full cash value of its holdings.

Kirkland Lake Makes Record Production

During the six months of the present year Kirkland Lake Mines produced approximately $1,500,000, which sets a new high record production in the history of the camp. The three largest producers during the six months were the Teck-Hughes, with an output of about $575,000; Wright-Hargreaves, which produced $420,000; and Lake Shore, $295,000. During the month of June the Lake Shore treated 1,950 tons and recovered $57,198, or an average of $29.34 a ton, which is a record month's production for this company. A dividend of 2 per cent has been declared, payable Aug. 15th to holders of record Aug. 1.

The Wright-Hargreaves has adopted the first mucking machine in the Kirkland camp, and if it proves to be successful there, it will no doubt be adopted by other properties. The Kirkland Proprietary is doing about 800 ft. of drifting and crosscutting a month. Most of this work is being done on the 550, 675, and 800 levels, and if the results during the next two or three months are satisfactory, it is proposed to start the mill by the end of the year.

Heavy Lake Shipments of Iron Ore

The movement of iron ore from the head of the Lakes to the present date is bearing out the early predictions of an excellent season. The shipments to date of 26,596,731 tons is surpassed only in the year 1918, when 29,609,000 tons had been shipped as of Aug. 1. The total shipments to date exceed by 9,303,218 tons for the same period in 1922.

The tonnage for the month of July for all the docks amounted to 10,411,248, which is in excess of 1,468,912 tons for 1922. Conditions are still favorable for a continuation of heavy shipments.

Idaho Platinum Bubble Bursts

Thorough Investigation Discloses Absence of the Metal From the Coeur d'Alenes

LAST SPRING after wide publicity had been given to the discovery of alleged rich platinum deposits near Coeur d'Alene Lake, in northern Idaho, Dr. Francis A. Thomson, representing the Idaho Bureau of Mines and Geology and a mining engineer and metallurgist of wide experience, undertook an independent investigation on the ground that if the reported discoveries were as represented it was a matter of great importance not alone to the State of Idaho but to the country at large. On the other hand, if the claimed deposits were found to be based upon bogus assays, it was even more important that the public should be informed of the facts through an independent and trustworthy channel.

Authoritative Commission Made Investigation

The commission making the investigation, in addition to Dr Thomson, follows: Dr. Francis B. Laney, representing the U. S. Geological survey; S. C. Lind, of the Bureau of Mines rare and precious metals station at Reno, Nev., who was not able to join personally in the investigation, but co-operated in the work; Raymond Guyer, president, and L. K. Armstrong, secretary of Columbia section A.I.M.E.; mining engineers of Spokane; and Rush J. White, mining engineer of Wallace, Idaho.

Accompanied by representatives of the companies, the commission secured samples at the Homebuilder, Caribou, and Wilson properties, and large samples were taken which the owners or their representatives agreed were fair and the same material from which they recovered platinum. The samples were taken to the state laboratory at Moscow and crushed to 40 mesh, separated into sixteen parts, and twelve samples sent to each of the following laboratories: U. S. Bureau of mines precious and rare metals station, Reno, Nev.; Idaho Bureau of Mines and Geology, Moscow, Idaho; Provincial Government assayer, bureau of mines, Victoria, B. C.; Colorado School of Mines, Golden, Colo.; Abbot A. Hanks, San Francisco, Calif.; Ledoux & Co., New York City; Canada Consolidated Smelting Co., Trail, B. C.; Anaconda Copper Mining Co., Great Falls, Mont.; American Smelting & Refining Co., Helena, Mont.; Bunker Hill & Sullivan Mining & Concentrating Co., Kellogg, Idaho; Irvington Smelting & Refining Works, Irvington, N. J. The report of the commission was given to the public by Dr. Thomson on July 23, in which its work was covered in much detail. Every one of the laboratories to which samples were sent reported no platinum.

In spite of this overwhelming evidence of fraud, representatives of the Caribou company have publicly announced that they would continue the construction of a mill, for they knew absolutely that they had platinum in paying quantities, regardless of the findings of the commission based upon the highest metallurgical authority. The assayer for this company is R. A. Dozier, formerly of Grants Pass, Ore., where he claims to have milling plant which is recovering platinum and in which a sample of Caribou ore was successfully treated for the platinum content.

The report of the commission gives four specific samples in which Dozier found platinum ranging from 3.35 oz. to 42 oz., and also iridium and gold, and in which the Idaho Bureau of Mines and Geology found nothing. The report also describes the "results" of two samples assayed by Dozier from the Wilson property. One of these was a piece of platinum weighing 1.25 mg. and the other two pieces weighing 1.54 mg., equivalent to 2.5 and 3.08 oz. of platinum per ton, the samples being from the same rock in which twelve of the best-known laboratories of the country found no platinum whatever. The report says that all three of these particles of platinum under the microscope are rectangular and show on their edges considerable evidence of having been clipped or cut with knife or scissors from a thin sheet of platinum or platinum foil.

Regarding the Homebuilder property, the report says: "With regard to the results said to have been obtained by C. C. Titus from ores of the Homebuilder company, we feel it best to withhold comment, except to state that his results have been uniformly lower than Mr. Dozier's, usually showing quantities of platinum less than 1 ounce to the ton."

Owners Have Been Mistaken in Their Supposition

In conclusion the report says: "Since the samples were carefully taken, under standard conditions and at points designated by approved representatives of the parties in question as those from which previous platinum assays had been returned, the conclusion seems clearly inescapable that the owners have been mistaken with regard to the existence in their properties of platinum in commercial amounts. So far as the local operators are concerned, there seems every reason to believe that they have been honestly convinced of the existence of platinum in their properties, and that the responsibility for the unjustified platinum boom at Coeur d'Alene City must be placed upon certain so-called assayers rather than upon the good citizens of Idaho, who are the owners of the properties in question."

Gold Rush to McNeil Township

Spectacular samples of free gold have recently been brought in from the Township of McNeil, in northern Ontario, which is a short distance from the Matachewan gold area and southeast of Porcupine. The veins consist of comparatively narrow quartz stringers in the porphyry, and some of the quartz stringers carry heavy free gold. No work has yet been done in the district, and it is too early to state what its possibilities are, but it has resulted in the largest rush seen in this country for some time. The original discoveries were made by Indians, who have sold their claims to a Toronto syndicate. The geology of the district is good, and prospectors consider it probable that a sufficient concentration of stringers will be found with values in the intervening porphyry to make it payable.

Mining Corporation Expands Its Holdings

The Mining Corporation has taken up a group of claims in the Gillies Limit, about five miles from the company's properties in Cobalt. Last spring a small silver discovery was made on one of the claims, but the geology of the section is favorable and the Mining Corporation proposes to sink a shaft to a considerable depth. The ground taken over embraces about 500 acres, and the work to be undertaken will be the first serious attempt in the Limit, aside from work accomplished on three properties which had silver showings on the surface. The Gillies Limit was withdrawn from staking by the government in the early days of the Cobalt camp. Later it was surveyed into 20-acre claims, which were sold by tender, and although substantial prices were paid for some of them, few discoveries of importance have ever been made in the Limit, and no really profitable mines have been found.

British South Africa Co. in Settlement With British Government

The directors of the British South Africa Co. have come to a provisional agreement with the British Government in regard to the assets that will be retained when constitutional government is granted to Rhodesia in October. The company will have all mineral rights recognized by the crown throughout southern and northern Rhodesia. The net income from these rights for the year ended March 31, 1922, was £129,000. The company will also have 14,000 square miles of mineral rights in Nyasaland and nearly 10,000,000 acres of land. A certain section of the shareholders believed to be those who wish to force Rhodesia to join the Union of South Africa, is opposing the settlement. If agreed to, the company will carry on as a commercial undertaking.

Plan for Copper Merger Agreed Upon

Committee Gives Out Details of Consolidation Proposed for Calumet & Hecla and Four Smaller Lake Superior Companies

A PLAN for the consolidation of the Calumet & Hecla, Ahmeek, Allouez, Centennial Copper, and the Osceola Consolidated mining companies has finally been agreed upon by the committee that has had it under consideration. As reported by the committee, the salient facts are as follows:

The authorized capitalization of the new company is to be 2,500,000 shares with a par value of $25 each, of which the new company will issue 2,005,502 shares to stockholders of constituent companies, the remaining 494,498 shares of the authorized stock to be reserved for general corporate purposes.

Shares of new company are allotted to constituent companies as follows:

	Shares Now Outstanding	New Shares
Ahmeek Mining Co.	200,000	536,000
Allouez Mining Co.	100,000	80,000
Calumet & Hecla Mining Co	800,000	1,205,308
Centennial Copper Mining Co.	90,000	34,000
Osceola Consolidated Mining Co.	96,000	149,994

The allotment to Calumet & Hecla does not include new shares to which its stockholders are entitled on account of shares owned in the other four companies. The allotment to other four companies represents the value of all their assets and includes new shares to the number of 378,692 issuable on account of shares of the four companies which Calumet & Hecla owns. This makes the total number of shares of the new company to be issued to Calumet & Hecla stockholders 1,584,000.

The rate of exchange of stock of the new company for the stock of the five consolidating companies is as follows:

For each share of Ahmeek, 2.68 shares; Allouez, 0.80 share; Calumet & Hecla, 1.98 shares; Centennial Copper, 0.38 share, and Osceola Consolidated, 1.56 shares.

In addition to the shares of the new company as has been set forth, the committee determined that there should be paid to the stockholders of the Ahmeek Mining Co. $5 a share of Ahmeek stock; to stockholders of Calumet & Hecla, $1.25 a share of stock of that company; and to stockholders of Osceola Consolidated, $1 a share of stock of that company. Payments are to be made from the assets of the respective companies and are conditioned on consummation of the consolidation. Payment to stockholders of Calumet & Hecla includes payments which the company would receive on shares owned by it in the Ahmeek and Osceola Consolidated.

The report says that the instability of the copper market and the substantial increase in the cost of labor, transportation, fuel and supplies have made it of utmost importance that Lake Companies effect every possible saving in operating costs, and that the proposed plan of consolidation affords an opportunity for reducing costs.

The properties of the five companies are contiguous, but are operated as independent units, which necessitates the maintenance of separate organizations, separate surface plants and separate underground workings, and also the maintenance of boundary barriers, which on consolidation can be mined at substantial profit. Consolidation would make it possible to eliminate much of the duplication both in surface plants and underground workings. Milling, smelting and refining can be centralized through joint use of all facilities and equipment.

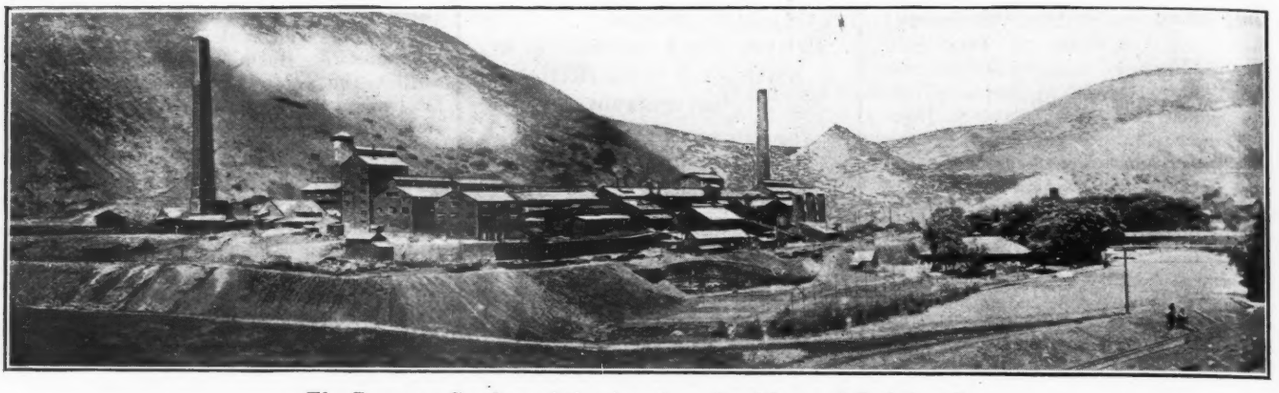
Affected by Labor Shortage

The chronic labor shortage in the Michigan copper district does not make available enough men to supply all mines with full operating crews, with the result that production must be curtailed and high costs incurred. With unified operation, increased elasticity of available labor and opportunity of placing and utilizing it to the best advantage will result in a larger, more stable and more profitable output.

If consolidation is effected, a new railroad is to be constructed to connect the Ahmeek, Allouez and North Kearsarge mines with the stamp mills by a direct route which will avoid the adverse grades of the Mineral Range Railroad over which rock is now carried. This will result in substantial reduction of transportation costs.

A policy of taking steps to acquire facilities for the manufacture of copper and brass products is under consideration, but this is deemed advisable only in case consolidation has an annual output large enough to warrant acquisition of facilities on a scale to permit economical and profitable operation.

The committee on consolidation is comprised of the following: R. L. Agassiz, president of Calumet & Hecla Mining Co., Ahmeek Mining Co., Allouez Mining Co. and Centennial Copper Mining Co., and vice-president of the Osceola Consolidated Mining Co.; Charles Hayden, of Hayden, Stone & Co.; William C. Potter, president of the Guaranty Trust Co.; J. H. Rice, president of the Houghton National Bank, Houghton, Mich., and Dr. Samuel W. Stratton, president of the Massachusetts Institute of Technology and formerly chief of the U. S. Bureau of Standards. Pope Yeatman, James R. Finlay and James F. Kemp, independent engineers, valued the various properties.



The Durango Smelter of the American Smelting and Refining Co.
The three large buildings to the left house the new sulphate plant, consisting of a roaster, leaching tanks and zinc sulphate treatment machinery

Sulphate Plant at Durango Making Progress

Unit Works Steadily on Complex Lead-Zinc Ores from Telluride

The new sulphating unit, constructed jointly by the Metals Exploration Co. and the American Smelting & Refining Co. at the Durango plant of the latter company, has been in operation since June 15, and with the exception of temporary shutdowns to adjust mechanical troubles has been in steady operation. Up to Aug. 1st approximately 1,000 tons of concentrates from the Black Bear properties was treated, with results that were extremely satisfactory to the company and giving every indication that the Sulphate or "Coolbaugh process" for treating complex zinc ores is a decided success. The new unit will treat seventy-five tons of concentrates in twenty-four hours, 50 per cent more than was expected.

The process itself is simple. The finely crushed ore or concentrate is roasted in a Skinner multiple-hearth furnace, with the roast so controlled that the metals are converted to sulphates. The hot calcine from the furnace is then leached with water and agitated. Zinc and copper sulphates are soluble in water, but the remainder of the sulphates, and other elements of the ore, are not. Lime or zinc oxide is added to the agitated solution, and the soluble copper precipitated as copper oxide, with the balance of the residue.

The zinc sulphate, which is the only soluble compound left, is filtered off, and the residue, containing all the gold, silver, lead, and copper, with a little zinc, is ready to be agglomerated on the Dwight-Lloyd sintering machines. The resulting product is then smelted in the regulation lead blast furnace.

The solution containing the zinc sulphate is treated in a Spray drier, where the zinc sulphate crystallizes. This method of crystallizing zinc sulphate produces a sulphate containing only two molecules of water of crystallization, in place of the normal seven, which is a saving of 10 to 20 per cent, when the shipment of the zinc sulphate is considered.

Present plans assume that this zinc sulphate will be marketed as such, but tests now being carried on may determine other forms of zinc which can be produced and sold.

News from Washington

By PAUL WOOTON
Special Correspondent

Sizing Up the Arsenic Supply

A questionnaire prepared by the U. S. Geological Survey is being sent to American consuls with the idea of securing further information as to prospective shipments of white arsenic to the United States. While the shortage of arsenic poisons is likely to be less acute next spring, it is the opinion of the Government specialists interested in this subject that the country will be able to consume, at much the same levels of price as those which have prevailed during the past year, all of the arsenic likely to be produced in this country or brought here from abroad.

It can be estimated very closely that 15,000,000 tons of refined white arsenic will be made available by the domestic plants. The uncertainty of the situation is the amount which may be expected from foreign sources. It is known that the information that the United States is in the market for arsenic at attractive prices, has percolated to the far corners of the earth. Arsenic is a widely distributed material. Under such circumstances it is believed advisable to secure all advance knowledge of imports to be expected.

Domestic production will not be decreased by the fact that some of the producers are closing their plants during the periods of greatest heat. They simply will allow the material to accumulate and push refining operations when weather conditions are more propitious.

Future of Radium Industry in United States Dark

Competition From Africa Unusually Keen

With the syndicate controlling the radium-bearing ore fields of the Belgian Congo announcing that its deposits are much more extensive than at first reported, and now talking about producing a kilo of radium, the future of this industry in the United States appears even more uncertain than before.

Only one domestic company is now in production, the United States Radium Co., which is using its product principally in luminous paints but also is offering radium on the market. A year ago there were six other companies producing radium in this country. The United States Radium Co. is producing from its own mines at Long Park, Colo., on the north side of Paradox Valley, and also is buying ore from the deposits owned by A. H. Balsley in Utah, which ore averages a little more than 4 per cent radium.

Apparently only new and greatly cheaper methods of treatment can restore the general domestic industry to a plane where it can compete successfully with the Congo radium. The average content of domestic ore has been slightly in excess of 2 per cent. The African deposits, according to reports, run 50 to 70 per cent U_3O_8, which brings the cost of reduction low. As the uranium ore is shipped with blister copper from the Congo mines, the item of freight is minor.

The price of radium in the United States, and practically the world price, has come down to $70 per unit since the Congo radium entered the market in volume, from a range of $110 to $120 previously. It is believed that the Belgian syndicate could cut this price.

Congo production began in 1922 in a field which has been one of the world's great copper producers. The mines, near Elizabethville, are controlled by the Union Minère du Haut Katanga, a British-Belgian syndicate.

Dr. F. L. Hess, rare minerals specialist of the United States Geological Survey, states that the structure being produced in the African field is pitchblende.

News from Mining Districts

By Special Correspondents in the Field

London Letter

Perseverance Mine May Be Revived—British Government Settling With Rio Tinto—National Mining Corporation Calls a 4s. Liability

BY W. A. DOMAN

London, July 26—The remark has frequently been made that mines—or rather mining companies—die hard. Once they are in existence and providing billets, the inclination is to keep the companies going—and frequently it has been profitable to all to do so. The Great Boulder Perseverance (Kalgoorlie) has been in liquidation for several years, and recently has been doing well, at least for a proposition that is being wound up. Not long ago the management at the mine was changed, and the new manager believes that he can convert the property into a payable proposition at a cost for development work of £35,000. The liquidator rather supports the new manager, although he appears somewhat illogical in his remarks, for he states in a circular that distributions must inevitably cease at an early date unless fresh money is provided under the new manager's scheme. The estimate of profits is £140,000 in four years from ore that is already developed. It would, of course, not be the first case of a mine being resuscitated, but it is a question of who will make the money out of it—the Stock Exchange or those who subscribe for new shilling shares of the company.

The Rio Tinto company has been much in the public eye of late. It will be remembered that during the war the company provided the Allies with cuprous pyrites and alleged that the government, in consideration of being supplied at pre-war rates, agreed to facilitate the supply of coal to the company, but failed to do so, and the company claimed £188,811 to cover the extra expense to which it was put in procuring coal. In various other ways a claim was made up for £955,000. The case was heard in 1922 and was then referred to the official referee to fix the amount to which the company was entitled, for pyrites. The company, it was agreed, were entitled to £182,500, together with £37,652 for extra freight. The government had already paid 12s. 3d. per ton on the 146,000 tons, and it is stated the balance will be adjusted.

PYRITES AGREEMENT CONSUMMATED

The pyrites agreement to which I have previously referred is now settled. A new company has been formed entitled The Pyrites Production Association, of which Sir Arthur Steel Maitland has been appointed chairman and J. E. Hunter the secretary. Sir Arthur states that the function of this association will be not so much to eliminate as to regulate competition with a view to stabilizing prices, which recently have fluctuated in a manner most detrimental to trade. The price of pyrites has fallen to a low level within recent years, and owing to the formation of the association considerable benefits are expected.

In consequence of the fact that the written-down shares of the National Mining Corporation carry a liability of 4s. a share, they have never been popular with the public and the quotation does not represent the value of the undertaking; the directors have now issued a circular calling up the liability. There are to be four calls of 1s. each, the last to be made on Sept. 15, 1924. The valuation of the assets shows a substantial surplus over the paid-up capital. The corporation is taking a prominent part in the development of the Comstock Merger Mines at Virginia City, Nev., and it is estimated that the ore reserves at June 30 were 235,000 tons proved, and 1,650,000 probable, with an estimated net profit exceeding $8,000,000.

John Taylor & Sons, who manage the Anglo-Canadian Explorers, Ltd., are sending out this week Kenneth B. Taylor and W. L. Bayley on business connected with this new undertaking, the object of which is to secure options on mining properties in Canada.

John M. Iles has resigned his position as consulting engineer to Rayfield (Nigeria) as from the end of last year. He will remain a director of the company and A. L. Butler will now manage the property. Apparently the change is made in the interest of economical operation.

TALK OF BOOM IN CANADIAN SHARES

Because the London Stock Exchange is dull, partly owing to politics and partly to the incidence of the holiday season, there is talk of arrangements being made for an autumn boom in Canadian mining shares. Certain financiers on this side have accumulated bundles of scrip, of which the public shows little inclination to relieve them. Consequently something has to be done. It is rumoured that H. G. Latilla, who is interested in the Kirkland Lake District, has had a disagreement with H. H. Johnston, who formerly acted as engineer for him and his group. H. S. Denny is now in Canada for H. G. Latilla, so it is said, to effect a consolidation of interests in the Salmon River district, for the purpose of the said autumn boom. He is also looking round for other claims.

The Namaqua Diamond Co. flotation, with which Sir Edward Mackay Edgar is connected, seems to be hung up temporarily. It is said that 10 per cent underwriting commission is being offered. Certain parties who were offered a participation have not jumped at the business.

BRITISH COLUMBIA

Dunwell Find Promising

The new find at the Dunwell mine is still the center of interest in the Bear River district. The latest information is that the crosscut has passed through 70 ft. of ore and the face still is in ore. Practically the whole width is believed to be milling ore: while 12 ft. gave an assay of $14 in gold and 11 oz. of silver per ton and 16 per cent of lead and another six feet about the same value in precious metals but with only a little lead. No drifting has been done on the vein since the oreshoot was reached. The whole of the work up to now has been done by hand, but the company has made arrangements with the owner of the old Portland Canal company's compressor for one-third of the air in consideration for repairing the flume and putting the plant in order. This will give power for two drills; the repair work is now under way.

Premier May Build Mill

Though no official confirmation is available, it is reported that the Premier Gold Mining Co. proposes to erect a 1,000-ton concentrating cyaniding plant at the mouth of the new tunnel, and to have it ready by the time that the tunnel cuts the main vein. The orebody has diminished in value, but has increased in size with depth. Transportation is the most costly single item of expense in treating the ore, and if the ore at depth is to be worked at a profit a large mill is essential.

High Grade Reported at Dunwell Mine

Excitement has been caused at Stewart, B. C., by the report of a strike of high-grade ore on the Dunwell mine, Glacier Creek, Bear River. No. 2 tunnel at the 280-ft. point, cut two veins. In crosscutting these, 10 ft. of ore carrying gold, silver and lead were found. This property is controlled in Victoria, B. C., the Stewart Land Co. being largely interested. The company's manager confirms the report outlined and is asking the Provincial Government to furnish aid for the improvement of transportation facilities in order that development may be pushed.

Cork-Province Resumes Shipments

The Cork-Province mine, it is reported, has shipped its first car of ore to the Trail smelter since resuming operations. Two more are ready for hauling, states W. H. Burgess, secretary of the company, and regular shipments are promised. Mine and mill are working smoothly. For the present zinc concentrate is to be stored.

Granby Activities

The Granby company has repaired the trestlework, carrying the railway between the mines and smelter at Anyox, and the furnaces were restarted on July 24. The plant now is in full operation again. The company

has bonded a number of claims adjoining the Outsider group, at Maple Bay. The new equipment at the Outsider is rapidly being put in place, and it is expected that shipping to Anyox will be started in September. Granby has bonded the Sultana group, at Boulder Creek, near Hazelton, and is exploring it with a diamond drill. About 50 men are employed on additions and repair work to the concentrator at Allenby. Power is supplied for both mine and mill by the West Kootenay Power & Light Co., the power resources of which already are being pretty severely taxed. Reopening Copper Mountain will mean re-starting the electrolytic copper refinery at Trail, and also putting the rod-mill in operation, power for both purposes being obtained from the West Kootenay company. The company, however, is making arrangements to double the capacity of its plant, and soon ample power will be available.

ONTARIO

Looking for a Power Shortage

There is considerable apprehension felt by mining men in the Kirkland Lake district of a serious shortage of power this fall, consequent upon the enlargement of operations by several companies. There has been no corresponding addition to the power transmission facilities, and charts at the mines show an unsteady current at frequent intervals. Some of the companies are considering the installation of Diesel oil engines, which are stated to have given excellent satisfaction in other mining fields.

Mining Corporation Makes Another Purchase

The Mining Corporation of Canada has acquired thirteen new claims in the Gillies Limit, about two miles south of Giroux Lake and five miles from the town of Cobalt. The ultimate purchase price is approximately $250,000.

Canadian Mines Prospect Intensively

Canadian Mines, Ltd., of London, England, represented by A. L. Webb, has secured the sole right to prospect for four years over an area of 54 square miles in the Goudreau Mining area, about two miles south of the property of the Nicholls Chemical Co. The company has a force of thirty prospectors at work on the property with I. Greene, of Toronto, geologist, in charge.

ALASKA

Fish Creek Mine Near Hyder Bonded

New York and London interests, represented respectively by Sam I. Silverman and H. S. Denny, have bonded the Fish Creek mine, situated about five miles from Hyder and one mile from the Alaskan-British Columbia boundary, from the American Mining & Milling Company, of Seattle. The American company has developed four veins in two tunnels, run a number of drifts, and opened stopes. About forty tons of high-grade has been shipped and there is a much larger tonnage broken and on the dumps. Recently the company started a lower tunnel to develop all the veins at depth, and, in the preliminary work, cut another strong vein, the existence of which previously was not known. The owners are continuing the tunnel.

Tanganyika Erecting Electric Furnace for Cobalt

An electric furnace is being erected at the Lubumbashi works of the Tanganyika Concessions for the treatment of the cobalt ores. This furnace will produce an alloy, which will be shipped to Europe and there refined and converted into a marketable product.

Radium is being regularly produced, and the needs of the whole world can be supplied. In the concession of the Nile-Congo Divide Syndicate, as a result of prospecting, twenty-six areas, each of 10 square miles, have been located for copper and gold. Additional prospectors have been sent out.

The only income received by the Tanganyika Concessions during the eighteen months was £1,202 in transfer fees. The result is a debit balance to profit-and-loss account of £59,580.

At the forthcoming meeting Robert Williams, the managing director, and chief engineer, is expected to make an interesting statement on his recent prolonged visit of inspection to the concessions.

QUEBEC

Power Co. Begins New Line Construction

The Quinze Power Co. has begun construction of the steel tower transmission line 125 miles in length from the Quinze to Porcupine, with C. F. Goodall in charge of the work. It is planned to erect from three-quarters of a mile to a mile per day, employing 1,000 men, which would enable the line to be completed by February or March next. About 350 men are working at the power site.

Rouyn Developments Add to Possibilities

The performance of assessment work in Rouyn Township has disclosed mineralization which adds materially to the value of the field. The most important feature is the discovery of feldspar porphyry intruding into the conglomerate rocks in the area lying to the south of Pelletier Lake, as well as the occurrence of a number of well-mineralized quartz veins in the sediments. This condition is similar to that obtaining in the producing area of Kirkland Lake, and tends to broaden the field of possibilities in the southern part of Rouyn Township.

CALIFORNIA

Mountain Copper Soon to Concentrate Ore

San Francisco Correspondence

The Mountain Copper Co. will be in condition to send ore to its concentrator by the middle of August. At its smelter at Martinez, 125 men are now employed in preparing to resume operations. In anticipation of the receipt of concentrates the furnaces have been fired, and it is expected that smelting will be resumed late in August. The Calaveras Copper Co. has resumed operations at Copperopolis and is operating its concentrator. The Walker Copper Co. has completed a new bunk house and has finished the foundation work on its new 600-ton mill. Late in August the Mountain Copper and Calaveras will be contributing to the California copper output. The Engels and Walker properties have been producing for some time. Thus four important copper properties will be in production.

Labor Shortage Acute

Labor shortage is being again felt along the Mother Lode. Apparently competition for labor is so keen that mine labor at $4.50 per day is difficult to get. Higher wages without greater efficiency are almost out of the question, as the gold mines are of low-grade and moderate tonnage. A campaign of education of the advantages of living conditions along the Mother Lode is suggested as a means for attracting labor. The cost of living is low and work is continuous. These are advantages that have been largely overlooked.

Electro-Metals Co. Vs. Fish and Game Commission

An interesting controversy is now going on between the Electro-Metals Co. of San Francisco, and the Fish and Game Commission of the state over certain water and power rights on the Klamath River. The controversy has arisen over the proposed development of a hydro-electric power project at Ishi Pishi Falls, the power from which is to be used in electro metallurgical operations. The company has asked for additional time within which to put the water to beneficial use. One department of the state has granted water rights to the company, but the Fish and Game Commission has opposed the company. The operations of this company will contribute measurably to the economic wealth of the state, and it is to be hoped that the present difficulty will be amicably adjusted.

Merced Limestone to Make Cement

Limestone deposits contiguous to Merced are to be developed and utilized in a projected cement plant. The Yosemite Portland Cement Co. proposes the immediate construction of a plant at Merced and the investment of $1,500,000 in the project.

A Mill for the Buzzard Hill Mine

A mill is to be installed by H. C. Cutting at the Buzzard Hill mine, near

Happy Camp, Siskiyou County. The Gearhart placer mine, north of Oak Bar, has been leased by A. A. Mosher and A. W. Cook, of Albany, Ore.

Alcalde Mine Resumes Milling

Milling has been resumed at the Alcalde mine, near Grass Valley. The Republic mine, near Graniteville, is operating ten stamps. The Gold Bluff mine, east of Downieville, has been leased to an English company represented by Harold Dardier.

Argonaut Asks to Have Assessment Reduced

Application has been made by the Argonaut Mining Co. to have the assessment reduced from $520,600 to $326,533, but the application has not been granted by the board of supervisors of Amador County. The mining company contended that it had operated at a loss of $29,207 for the last three years.

NEVADA

Goldfield Deep Mines Shaft Repaired

Shaft repair and cement work has been practically completed in the shaft of the Goldfield Deep Mines Co., and sinking will soon be resumed. The present depth of the shaft is 1,420 ft. and sinking has only 900 ft. to go to reach the projected position of the main vein system of the Goldfield district. The bottom of the shaft is in dacite, which is a favorable formation, and the future work will be watched with keen interest by all who are interested in the future of Goldfield.

Leasers Busy on Florence

Three sets of leasers are at work in the Florence mine, all of which show promising conditions. In the Biltoft block a winze is being sunk on a small shoot of $500 ore. In the King block, at a point about 200 ft. northwest of the main shaft, a drift started on a low-grade vein exposed in a crosscut in the old company workings, in the footwall of the regular Florence vein system, now shows one foot of quartz carrying fair values. This vein has not been previously prospected and there is a large block of virgin ground ahead.

Goldfield Cons. Shipping Irregularly

The Goldfield Consolidated has several sets of leasers at work and irregular shipments are maintained to Tonopah mills. It is understood that all future shipments will be sent to the mill of the Tonopah Mining Co. at Millers, by agreement between the two companies.

Middle Mines Sinking Winze

Development work continues on the Middle Mines group, under option to the Comstock Merger Mines Co. A winze is being sunk from the Hale & Norcross tunnel level, in Savage ground, and lateral work will be done from the winze. In the south end the company is working through two winzes, at a depth of 460 ft., sunk in Chollar ground by the Comstock Leasing Co.

Leadville Deep Drainage Project Progressing

Good progress is being made by the Leadville Deep Mines Co. in their project, comprising the most extensive draining enterprise ever undertaken in the Leadville district. The company controls by purchase and lease a large group of well-known properties in what is known as the Graham Park Basin. The first installation is being made at the Pyrenees shaft, where a Layne-Bowler electrically-operated pump is being placed. The pump is guaranteed to lift 2,200 gal. per minute. A second pump of like capacity is to be installed in the Greenback shaft. It is expected that the first unit will begin lifting water before the end of the present month. It is estimated that from eight months to a year will be required to drain the properties, and from a quarter to a half million dollars will be spent before the ore zones are reached.

Square Set Stope Begun in Consolidated Virginia

The recent strike on the 1,400 level of the Consolidated Virginia is reported to be improving with development, and a square set stope, three sets wide, has been started. Good mill ore is also being blocked out on the 1,465 and 1,650 levels.

United Comstock Moves Surface Equipment

The United Comstock has moved the surface equipment of the Knickerbocker shaft to the Overman shaft and the latter is to be repaired and retimbered where necessary. Mill tonnage at the United Comstock continues satisfactory.

O. S. L. to Build Wells-Rogerson Line

The *Nevada Mining Press* of July 27 states that the Oregon Short Line is to proceed at once with the construction of the Wells-Rogerson railroad, from Wells, Nev., to Rogerson, Idaho, a distance of 90 miles. The road is to be standard gage, is estimated to cost $5,094,000, and is to be completed before July 1, 1924. By the completion of this road a direct line will be established from the farming districts of Idaho and the Pacific Coast markets, and it will make possible the working of some mining camps in Nevada and Idaho which have hitherto been held back by high cost of transportation. The copper camp of Contact is probably the most important of the known camps to benefit. This district has produced a large tonnage of high-grade copper ore, but its future depends on the large bodies of lower-grade smelting ore. It is freely predicted that a smelter will be built at or near Contact as soon as the railroad project is completed to its destination.

COLORADO

Electrical Haulage at A. V. Smelter

Outstanding features reflecting increasing activity in the Leadville district are improved smelting conditions and the inauguration of new mining enterprises. Recent improvements at the Arkansas Valley plant of the American Smelting & Refining Co., comprising the installation of an electrically-operated haulage system between the roasting plant and the blast furnaces, will greatly facilitate ore movements and appreciably reduce the cost of handling the product. The advantage of the new system lies principally in the elimination of much manual labor and extra handling of the sinter which reaches the furnaces in much better shape than under former methods. These and other improvements recently installed have resulted in savings which are of substantial benefit to both the smelter and the ore shipper.

Zinc Oxide Plant Working Well

The sixteen furnaces of the new zinc oxide plant continue in steady operation, treating about 50 tons of ore daily. Large supplies of fuel are being stored to eliminate danger of a shortage on account of winter blockades.

Owing to better prices for manganese, there is an increased activity in the mining of these ores. The Carbonate mine on Carbonate Hill is steadily shipping a 35 per cent product to the Tennessee Coal, Iron & Railroad Co. at Birmingham, Ala. Arrangements are being made to resume operations on the A. V. shaft, which produced considerable quantities of manganese during the war.

WASHINGTON

Magnesite From Valley Moving Into Consumption

Approximately 20,000 sacks of Hawkeye Feltstone magnesite have been sold during the last six months, and jobbers in practically every large city in the West and towns and cities of the Inland Empire are now handling the stucco and flooring material being manufactured by the Spokane company, according to W. G. Ramage, president.

"The Hawkeye Feltstone Co. has been in operation about six months," said Mr. Ramage recently. "We mine our own magnesite and marble up in the hills near Valley, Stevens County, Wash., and it is crushed and ground at the quarries and trucked to Valley, where it is shipped to Mead, a few miles from Spokane's business center. At Mead we have our big plant, where we mix it and sack it ready for market.

MONTANA

Lukens-Hazel Mine Begins Operating

After several weeks spent in thoroughly overhauling the mill at the Lukens-Hazel mine, eight miles south of Libby, all alterations and improvements have been completed and the mill

began operating recently. The work was under the supervision of R. S. Handy, mill superintendent for the Bunker Hill & Sullivan, and George Graham, mill foreman for the same company. For some time a crew has been at work in the mine, getting out ore, with a night shift on duty.

Scratch Gravel to Resume

Operations will be resumed by the Scratch Gravel Mining Co. in the near future after a shutdown of several years, according to announcement made recently by John F. Davies, president of the company. The property is in the Scratch Gravel hills within a few miles of Helena, and has produced $350,000 in gold.

A new board of directors has been elected and the capital stock increased from $1,000,000 to $2,000,000.

"Negotiations are under way for the purchase of 240 acres adjoining the property," said Mr. Davies recently. "In fact, these negotiations are virtually completed. We will probably not unwater the mine, but will prospect the surface, where the values seem to lie and from where most of the paying ore has been taken."

New officers of the company are Mr. Davies, president; D. J. Fitzgerald, vice-president; Colonel W. E. Abercrombie, treasurer, and T. B. Miller of Helena, secretary. These officers, together with Frank R. Crowe, of Spokane, form the board of directors.

IDAHO

Idaho Gold & Ruby Cleaning Up

After fourteen years of effort, the first production of the Idaho Gold & Ruby mine is expected within 30 days, according to official reports received at Spokane, Wash. Results of the long-promised clean-up are being watched with interest not only by the stockholders but by mining men of the Northwest.

Under direction of Howard H. Sutherland, final preparations for the expected clean-up are under way. Sluice boxes are now being put on the bed rock in the main canyon. The bottom of the canyon is being cleaned from a point about 100 ft. upstream from the top of the big cut.

UTAH

Ore Shipments for the Week Ended July 28

Eureka—Shipments from this camp amounted to 142 cars, compared with 156 cars the week preceding. Shippers were: Chief Consolidated, 54 cars; Tintic Standard, 46; Dragon, 11; Eagle & Blue Bell, 7; Victoria, 7; Iron King, 6; Iron Blossom, 4; Swansea, 2; Centennial-Eureka, 2; Bullion-Beck, 1; American Star, 1; and Plutus, 1.

Park City—Shipments from this camp amounted to 3,115 tons, compared with 3,197 tons the week preceding. Shippers were: Park City Mining & Smelting, 1,375 tons; Silver King Coalition, 1,259 tons; Park-Utah, 491.

Inspector's Visit Improves Ventilation

Extensive improvements have been made in the matter of mine ventilation in Oklahoma, as a result of a recent visit by John D. Almand, Oklahoma mine inspector for district No. 3. After he arrived and had made cursory examinations, one zinc mine was closed and it was predicted others would be. However, instead there was a rush for big blower fans, and a quantity purchased by a local machinery firm from a United States shipyard last winter were quickly sold out and more have been ordered. Almand declares he will insist on good ventilation in the zinc mines.

ARIZONA

His Claims Appropriately Baptized

There may be nothing in a name, but just the same, it is evident that Tol Kinsey, sheriff of Gila County, Ariz., had his mind on riches when he named two mining claims that he recently located in the Globe district. One of the promising areas is titled "Henry Ford" and the one alongside it is named "John D."

Verde Central Exploratory Work Is Promising

The face of the 1,005 drift, which is being driven on the contact in the Verde Central mine, is reported to be in 10 per cent copper ore. A commercial orebody on that level has been opened that assures making Verde Central a coming producer of the Jerome district, and developments that are being rushed opening up this level are looked to with interest by the mining people of Arizona. The 1,005 drift has been in ore for a distance of 202 ft. and at present the face is entirely in the ore and neither wall is visible within that width. The ore is chalcopyrite, in a black schist, and it is estimated that an average for the drift would approximate 7 per cent. A crosscut is to be driven to determine the width of the ore. Four drifts are now being driven on this level, and are in ore, and it is believed that a large orebody will be developed The Calumet & Arizona is interested in the Verde Central and is aiding in financing development work.

Wenden Copper to Sink a Shaft

The Wenden Copper Mining Co. at Wenden, Ariz., is rushing the work of extending the east drift on the 200 level, and it is planned to sink the shaft to a depth of 600 ft. This property was first opened in 1916 and shipments of ore containing 10 per cent copper and $17.50 gold were treated at the Humboldt smelter.

MICHIGAN

Arcadian Consolidated Stockholders Pay Up

Stockholders of Arcadian Consolidated, in the Michigan copper district, are paying the assessment promptly, and the delinquent list will be small. Opening work is well under way in the New Arcadian shaft, drifting proceeding north on two levels, the ninth and twelfth. Both of these drifts are in copper. Dewatering of the shaft will proceed to the bottom or 1,850 level. Sinking then will be resumed. Plans for re-equipping New Baltic shaft with a hoist to replace the one destroyed by fire some time ago are still indefinite, but no doubt will be formulated before the close of the present year.

Calumet and Hecla Building New Shafthouse

At Calumet & Hecla, in the Michigan copper district, a new shafthouse is being erected at No. 5 Tamarack, the main drainage shaft of the conglomerate department. The old structure is being dismantled. Six electric pumps will be installed in the shaft to replace the present bailing system. Electric pumps also will be used in No. 1 Tamarack shaft. These pumps will reduce costs and easily handle the flow from the conglomerate shafts.

JOPLIN-MIAMI DISTRICT

Krape Lead & Zinc Completes Concentrator

The Krape Lead & Zinc Co. has completed and placed in operation a concentrating plant on a lease of the Leonard land, at Chitwood, in the northwestern part of Joplin. It has been built on the site of the old B. & M. mine, and operations are being conducted at a depth of 117 ft. Peter Vancil, of Joplin, is superintendent, and the property is owned by Denver men.

Large Drill Hole at the Ellis Mine

The Inter-State Zinc-Lead Corporation is putting down a 27-in. drill hole at its Ellis mine, near Crestline, Kan., northwest of Joplin. The drill hole is the largest so far put down in this field, and is to be used for draining purposes. The Ellis mine was started up some weeks ago, but the water proposition was too heavy. At present the big drill hole is down to a depth of only about 165 ft., but it will be sunk to the 200 level and draining carried on, after which the shaft at the mine, which is down only 135 ft. will be pushed to the deeper level and give an ore face of approximately 50 ft.

Beaumont Mill Resumes

Operations have been resumed at the Beaumont mill, in the Kansas field, after an idleness of several months during which repairs were made at the property. Fred Childress is manager.

Mine Owners Continue Curtailment

Curtailment of production is being maintained in this field through co-operation of the mining companies to a degree never before attained. Producers are convinced some good has been done in the way of holding up zinc ore prices by the curtailment and are anxious to continue the good work. All they are asking is that prices become high enough to permit them to operate their mines at a profit.

THE MARKET REPORT

Daily Prices of Metals

Aug.	Copper, N. Y. net refinery* Electrolytic	Tin 99 Per Cent	Tin Straits	Lead N. Y.	Lead St. L.	Zinc St. L.
2	14.10	37.75	38.125	6.525	6.60	6.15@6.20
3	14.10	37.75	38.125	6.525	6.55	6.15@6.20
4	14.00@14.125	37.25	37.75	6.525	6.55	6.15@6.20
6	14.00@14.125	37.75	38.125	6.525	6.50	6.15
7	14.00@14.125	37.875	38.375	6.525	6.45@6.50	6.15
8	14.00@14.125	38.50	38.875	6.525	6.45@6.50	6.125
Av.	14.075	37.813	38.229	6 525	6 525	6.158

*These prices correspond to the following quotations for copper delivered: Aug. 2d and 3d, 14.35c.; 4th to 8th, inc., 14.25@14.375c.

The above quotations are our appraisal of the average of the major markets based generally on sales as made and reported by producers and agencies, and represent to the best of our judgment the prevailing values of the metals for deliveries constituting the major markets, reduced to the basis of New York cash, except where St. Louis is the normal basing point, or as otherwise noted. All prices are in cents per pound. Copper is commonly sold "delivered," which means that the seller pays the freight from the refinery to the buyer's destination.

Quotations for copper are for ordinary forms of wire bars, ingot bars and cakes. For ingots an extra of 0.05c. per lb. is charged and there are other extras for other shapes. Cathodes are sold at a discount of 0.125c. per lb.

Quotations for zinc are for ordinary Prime Western brands. Quotations for lead reflect prices obtained for common lead, and do not include grades on which a premium is asked.

The quotations are arrived at by a committee consisting of the market editors of *Engineering and Mining Journal-Press* and a special representative of the Bureau of Mines and the Bureau of Foreign and Domestic Commerce.

London

Aug.	Copper Standard Spot	Copper Standard 3M	Copper Electrolytic	Tin Spot	Tin 3M	Lead Spot	Lead 3M	Zinc Spot	Zinc 3M
2	64¼	65	71½	182¼	183¼	24⅛	23⅞	30⅞	30⅝
3	64½	65¼	71½	181⅜	182⅜	24	23¾	31¼	30¾
6	...	...	...	....	....	...	...	...	...
7	64⅝	65½	71¼	181¾	182¾	24	23¾	31¼	30¾
8	64⅞	65⅜	71	184½	185	24⅛	23⅞	31⅜	31

The above table gives the closing quotations on the London Metal Exchange. All prices in pounds sterling per ton of 2,240 lb.

Silver, Gold, and Sterling Exchange

Aug.	Sterling Exchange "Checks"	Silver New York	Silver London	Gold London	Aug.	Sterling Exchange "Checks"	Silver New York	Silver London	Gold London
2	4.56½	62¾	30 15/16	90s 3d	6	4.56⅛	62⅝	...	... ..
3	4.56⅜	62¾	30 15/16	90s 2d	7	4.56	62¾	31	90s 3d
4	4.56⅞	62⅝	30⅞	.....	8	4.56	62⅝	30 13/16	90s 4d

New York quotations are as reported by Handy & Harman and are in cents per troy ounce of bar silver, 999 fine. London silver quotations are in pence per troy ounce of sterling silver, 925 fine. Sterling quotations represent the demand market in the forenoon. Cables command one-quarter of a cent premium.

Metal Markets

New York, Aug. 8, 1923

The metal markets are exhibiting expected midsummer dullness. Scattering orders, some of good proportions, have been received but the total volume of sales has not been large. Prices are substantially unchanged from those recorded last week and there seems to be no great pressure to sell on the part of producers.

Copper

The feature of the week was the placing of the Western Union order for 5,000,000 lb. which was mentioned in the report of last Wednesday as attracting considerable competition. The market has been substantially unchanged throughout the week, with producers generally quoting 14⅜c. delivered, but selling only small tonnages at that level. In one or two directions, beginning Saturday, it has been possible to do 14.25c., and even this price has been shaded slightly where the consumers' plants are situated near refineries so that the freight charge is a small item. The price is holding up well, however, considering the meager business.

Consumers report an expectation of good business in the fall. It is said that the American Brass Co. is actively competing for all the business in sight, being able to sell cheaper than other brass mills owing to the cost of their copper being merely a book figure, whereas other manufacturers must make a definite margin above the cost of copper and zinc in the open market. Thus is one of the advantages of the Anaconda-Chile-American Brass merger in evidence, according to report.

The foreign copper market has been inactive all week, with stiff competition for what little business was placed.

Lead

The official price of the American Smelting & Refining Co. continues at 6.50c. New York.

Business was on a good scale on Thursday and Friday but since then inquiries have shown a pronounced tendency to fall off and yesterday and today few orders were placed. Producers are not worrying the slightest bit, however, as they have sold practically all of their August lead and expect no difficulty in disposing of their September output; in fact, a considerable quantity for September has already been sold by those who have opened their books. The London price is holding up well despite the fact that all of the Mexican and foreign production continues to be absorbed in foreign markets. There is less of a tendency for buyers to pay premiums above the Smelting company's price, though many producers continue to ask such premiums. Occasional carloads of spot lead continue to bring from 6.75 to 7c.

In St. Louis, the market has shown a weaker tendency and the premium over the New York price has disappeared. It would not be surprising to see the differential as much as 25 points soon, as that is a more normal state of affairs.

Zinc

The zinc market has been quiet during the week with most of the sales confined to rather small tonnages for August and September delivery. A slight premium would be asked for October and later, but this forward business has been insignificant. Some producers report a somewhat firmer feeling today, but the higher prices seem to be only nominal as several hundred tons were sold at 6.10 and 6.125c.

High-grade is unchanged at 8@8.50c., delivered.

Tin

There has been little interest from consumers and most of the sales have been between traders at prices substantially below import cost. When

the price shows a bulge upward, as it does today, consumers are almost entirely out of the market. Spot and forward deliveries have been obtainable at about the same prices.

Arrivals of tin during July were 5,205 long tons, classified as follows according to the New York Metal Exchange:

	July, 1923	Seven months 1923
Straits	3,305	29,615
English	1,015	4,225
Chinese	805	4,404
Banka and Billiton	75	2,728
Australian	5	330
Total	5,205	41,302

Arrivals in August: 1st, Hamburg, 25; Java, 400; Straits, 535; Liverpool, 100; China, 10; 3d, Havre, 25; Straits, 100; 6th, Straits, 230; 7th, Liverpool, 210; total so far in August, 1,735.

Silver

The market has been quiet and featureless for the past week with no apparent tendencies. The holiday on Aug. 6 in London, Shanghai and Hongkong added to the general dullness. Continued buying by the Indian Bazaars and sales from the continent accounted for the small fluctuations in price.

Mexican Dollars—Aug. 2d, 47⅞; 3d, 47⅞; 4th, 47¾; 6th, 47¾; 7th, 47⅞; 8th 47¾.

Treasury Circulation Statement

Stock of money in the United States, July 1: Gold coin and bullion, $4,049,150,897; standard silver dollars, $491,889,404; subsidiary silver, $269,159,681; United States notes, $346,681,016; Federal Reserve notes, $2,676,902,380; Federal Reserve Bank notes, $22,083,000; National Bank notes, $747,439,719; total, $8,603,306,097. Money in circulation per capita, $42.51, the population of the country being estimated at 111,268,000. The gold stocks increased by $26,000,000 during June, the silver stocks remaining substantially unchanged.

Foreign Exchange

Since last week, practically all of the exchanges have reflected the unsettled foreign situation and French and Belgian francs have been particularly weak. German marks seem due for a complete extinguishment at an early date, and they will probably be superseded by certificates for the new internal gold loan of 500,000,000 marks, provided it is successful, which will be issued in small denominations. This new currency would, of course, be on a gold basis, and the currency now in use, would presumably be worth nothing. So far as its use in international trading goes, it has for some time been superseded by dollars or the pound sterling, and will no longer be quoted here. On Tuesday, Aug. 7, cable quotations on francs were 5.695c., and on lire, 4.31c. Canadian dollars, 2¼ per cent discount.

Other Metals

Quotations cover large wholesale lots unless otherwise specified.

Aluminum—99 per cent grade, 26@27c. per lb.; 98 per cent, 25@26c. London, £115, 98 per cent.

Antimony — Chinese and Japanese brands, 7⅞c. W.C.C. brand, 8½c. Cookson's "C" grade, 10@10.50c.

Bismuth—$2.55 per lb. London, 10s.

Cadmium—$1 per lb. London, 4s. 6d.

Cobalt—$3 per lb. for spot.

Iridium—$275@$300 per oz.

Nickel—27@32c. per lb. for 99 per cent virgin metal. London, £130 per long ton.

Palladium—$80@$81 per oz.

Platinum—$116 per oz. London, £24 15s.@£25.

Quicksilver—$66 per 75-lb. flask. Quiet. San Francisco wires $65.35. London, £10.

The prices of **Magnesium, Molybdenum, Monel Metal, Osmium, Radium, Rhodium, Selenium, Tellurium, Thallium,** and **Tungsten** are unchanged from prices given Aug. 4.

Metallic Ores

Chrome, Iron Ore, Magnetite, Manganese, Molybdenum, Titanium, Tungsten, Vanadium, and **Zircon Ore** are unchanged from the quotations published Aug. 4.

Zinc and Lead Ore Markets

Joplin, Mo., Aug. 4—Zinc blende, per ton, high, $40.10; basis 60 per cent zinc, premium, $39.00; Prime Western, $36@$37.50; fines and slimes, $35@$34; average settling price, all zinc ores, $36.78.

Lead, high, $81.10; basis 80 per cent lead, $75; average settling price all lead ores, $73.64 per ton.

Shipments for the week: Blende, 7,855; lead, 618 tons. Value, all ores for the week, $335,570.

The premium price paid for zinc ore was for a limited tonnage of lead-free ore, whereas the purchasers for the manufacturers of rolled zinc offered only $37.50 for ore of low lead content.

In former years following a movement to restrict the output it was evident that the production gradually climbed upward. Checking and rechecking the present output indicates a restriction of production to a tonnage less than at first estimated. It appears now that the production is less than 8,000 tons per week.

Platteville, Wis., Aug. 4. — Blende, basis 60 per cent zinc, $41.50 per ton. Lead, basis 80 per cent lead, $70 per ton. Shipments for the week: Blende, 190 tons; lead, none. Shipments for the year: Blende, 19,348; lead 460 tons. Shipments for the week to separating plants: 542 tons blende.

Non-Metallic Minerals

Asbestos—Crude No. 1, $375@$500; No. 2, $225@$325; spinning fibers, $150@$225; magnesia and compressed sheet fibers, $100@$150; shingle stock, $55@$60; paper stock, $35@$45; cement stock $20@$25; floats, $9@$12. All f.o.b. mines, per short ton, Quebec.

Barytes, Bauxite, Borax, Chalk, China Clay, Diatomaceous Earth, Emery, Feldspar, Fluorspar, Fuller's Earth, Graphite, Gypsum, Limestone, Magnesite, Manjak, Mica, Monazite, Phosphate, Pumice, Pyrites, Silica, Sulphur, Talc and Tripoli are unchanged from the Aug. 4 prices.

Mineral Products

Arsenious Oxide (white arsenic)—9@9½c. per lb., delivered over the balance of the year.

Copper Sulphate—5.25@5.45c. per lb., domestic product.

Sodium Nitrate—$2.45 per 100 lb., ex-vessel, Atlantic ports.

Potassium Sulphate and **Sodium Sulphate** are unchanged from quotations of Aug. 4.

Ferro-Alloys

Ferromanganese—Domestic and imported, $117.50 per long ton. Spiegeleisen unchanged from Aug. 4 prices.

Ferrocerium, Ferrochrome, Ferromolybdenum, Ferrosilicon, Ferrotitanium, Ferrotungsten, Ferro-uranium and **Ferrovanadium** are unchanged from the prices published Aug. 4.

Metal Products

Copper — Sheets, 23½c. base; wire, 17⅞c.

Lead Sheets, Nickel Silver, Yellow Metal, and **Zinc Sheets** are unchanged from the prices given in the Aug. 4 issue.

Refractories

Bauxite Brick, Chrome Brick, Firebrick, Magnesite Brick, Magnesite Cement, Silica Brick and **Zirkite** are unchanged from the Aug. 4 prices.

The Iron Trade

Pittsburgh, Aug. 7, 1923

There is a better tone in finished steel products, with perhaps slightly increased buying. The chief point seems to be that there is more confidence, owing to the fact that the steel price structure has held intact despite the general conservative feeling in business circles and the large declines that have occurred in coke, scrap and pig iron. All three of those markets are now showing decided resistance to further declines.

Pig Iron—Prices have not declined in the week. The market is hardly as inactive, and is showing resistance to further declines; Bessemer, $26.50; basic, $25; foundry, $25@$26, f.o.b. Valley furnaces.

Connellsville Coke — Furnace, $4@$4.50; foundry, $5.25@$5.50. Sales of furnace coke at under $4.50 were distress lots.

Freight Rates on Metals, Ores, and Concentrates

In Carload Lots

Freight Rates on Copper Bullion and Refined Copper

From	To	Rate per Ton of 2,000 Lb. All Rail	Via Gulf
El Paso, Tex.	Baltimore, Md.	$13.40	.....
Garfield, Utah	Perth Amboy, N. J.	16.50	.....
Garfield, Utah	San Francisco	5.85	.....
Hayden, Ariz.	Perth Amboy, N. J.	16.50	$14.50
Miami, Ariz.	Perth Amboy, N. J.	16.50	14.50
Anaconda, Mont.	Perth Amboy, N. J.	16.50	.....
Butte, Mont.	Perth Amboy, N. J.	16.50	.....
Humboldt, Ariz.	Chrome, N. J.	16.50	14.50
Douglas, Ariz.	Perth Amboy, N. J.	16.50	14.50
Globe, Ariz.	Perth Amboy, N. J.	16.50	14.50
Clifton, Ariz.	Perth Amboy, N. J.	16.50	14.50
Clarkdale, Ariz.	Chrome, N. J.	16.50	14.50
Copperhill, Tenn.	Laurel Hill, N. Y.	10.80	.....
Tooele, Utah	Chrome, N. J.	16.50	.....
McGill, Nev.	Baltimore, Md.	15.90	.....
Houghton, Mich.	New York	(a) 9.60	.....
Hancock, Mich.	New York	(a) 9.60	.....
Hubbell, Mich.	New York	(a) 9.60	.....
Dollar Bay, Mich.	New York	(a) 9.60	.....
Tacoma, Wash.	New York Conference rate $6.00 via Canal*		
Anaconda, Mont.	Tacoma, Wash.	7.09	.....
Ajo, Ariz.	New York	16.50	14.50

(a) Applies April 1 to Nov. 30 of each year.

Lead Bullion; Also Pig Lead Where Shown

From	Rates per Ton of 2,000 Lb. To New York	To St. Louis
East St. Louis, Ill.	$7.00	.....
Pueblo, Colo.	14.15	$9.65
Leadville, Colo.	16.50	11.40
East Helena, Mont.	16.50	11.40
El Paso, Tex.	(c) 12.00 Via Gulf (c) 14.00 All Rail	(b) 7.76½
Omaha, Neb.	9.60	3.65
Murray, Utah	16.50	11.40
Midvale, Utah	16.50	11.40
Tooele, Utah	16.50	11.40
East Chicago, Ill.	6.40	(a) 2.00
Kellogg, Idaho	16.50	11.40
Carnegie, Pa.	3.80	(a) 5.00
Selby, Calif.	Conference Rate $6.00 via Canal	
Herculaneum, Mo.	(a) 8.80	(a) 1.80
Federal, Ill.	7.00	(a) 1.80
Collinsville, Ill.	7.00	(a) .75½
Granby, Mo.	(a) 10.50	(a) 3.50
Joplin, Mo.	(a) 10.50	(a) 3.50

(a) Pig lead only.
(b) Pig lead only when originating in Mexico.
(c) Shipments of bullion originating in Mexico, $2 per ton less.

Zinc

From	Rates per Net Ton To East St. Louis	To New York
Donora, Pa.	(a) $4.60	$3.80
Langeloth, Pa.	(a) 4.60	3.80
Palmerton, Pa.	*7.10	3.00
Hillsboro, Ill.	1.40	7.00
Danville, Ill.	2.00	6.40
La Salle, Ill.	2.00	6.70
Springfield, Ill.	3.00	7.00
Cleveland, Ohio	5.80	6.40
Moundsville, W. Va.	4.40	3.80
Van Buren, Ark.	3.80	10.80
Fort Smith, Ark.	3.80	10.80
Bartlesville, Okla.	3.50	10.50
Blackwell, Okla.	3.80	10.80
Henryetta, Okla.	3.80	10.80
Sand Springs, Okla.	3.80	10.80
Cherryvale, Kan.	3.50	10.50
Black Eagle, Mont.	9.40	14.50
Park City, Utah	11.40	16.50
Canyon City, Colo.	15.55	22.55

(a) To St. Louis, Mo.

Zinc Ores and Concentrates to Oklahoma Smelters

Commodity	To	From	Rate per Net Ton
Zinc ore and concentrates, carloads	Bartlesville, Okla.	Altoona, Kan.	$2.10
		Pittsburg, Kan.	*1.10
		Galena, Kan.	1.30
		Joplin, Mo.	1.40
		Iola, Kan.	*1.10
		Baxter, Kan.	1.40
		Miami, Okla.	1.40
		Quapaw, Okla.	1.40
		Kansas City, Mo.	1.60
Zinc ore and concentrates, carloads	Sand Springs, Okla.	Miami, Okla.	2.20
		Quapaw, Okla.	2.20
		Galena, Kan.	1.50
		Joplin, Mo.	1.50
		Iola, Kan.	2.40
		Cave Springs, Mo.	2.00
		Cent City Spur, Mo.	2.00
Zinc ore and concentrates, carloads	Dewar, Okla. Kusa, Okla. Henryetta, Okla.	Chitwood, Mo.	2.00
		Galena, Kan.	1.50
		Iola, Kan.	2.40
		La Harpe, Kan.	2.40
Zinc ore and concentrates, carloads	La Harpe, Kan.	Mound City, Kan.	.50
		Oswego, Kan.	.50
		Parsons, Kan.	.50
Zinc ore and concentrates, carloads	Coffeyville, Kan.	Galena, Kan.	1.10
		Joplin, Mo.	*1.22
Lead ore and concentrates, carloads	Bartlesville, Okla.	Baxter, Kan.	1.80
		Miami, Okla.	1.80
		Quapaw, Okla.	1.80

Rates on Ores and Concentrates

From	To	Value of Product $5	$10	$15	$20	$25	$30	$35	$40	$50	$60	$70	$75	$80	$90	$100
		Rate														
Butte, Mont.	Anaconda, Mont.	.17	.17	.17	.17	.17	.17	.17	.17	.17	.17	.17	17	.17	.17	.17
Butte, Mont.	Black Eagle, Mont. (a)	....	....	....	....	....	....	1.02	1.01	....	....	....	....	....	....	....
Great Falls, Mont.	East Helena, Mont.	....	....	1.57	....	1.76	....	1.98	....	2.43	....	....	....	....	....	*2.55
Butte, Mont.	East Helena, Mont.	....	....	1.17	....	1.46	....	1.69	....	2.03	....	....	....	....	....	2.14
Paxton, Calif.	Salt Lake Smelters, Utah	....	....	....	....	....	....	....	....	6.30	7.00	7.70	....	8.35	8.60	8.85
Johannesburg, Calif.	Selby, Calif.	....	....	....	*2.90	....	*3.50	....	*4.10	*4.70	*5.30	*5.90	....	*6.50	*6.80	*7.10
Johannesburg, Calif.	Humboldt, Ariz.	....	....	....	3.40	....	4.10	....	4.80	5.50	6.20	6.90	....	7.60	8.00	8.30
Pioche, Nev.	Humboldt, Ariz.	....	4.50(c)	7.74	....	8.55	....	9.36	....	9.99	....	....	11.25	....	....	12.42
Creede, Colo.	Durango, Colo.	....	....	3.25	3.50	3.75	4.00	....	4.25	4.75	5.25	5.75	6.05	....	....	7.10
Ouray, Colo.	Durango, Colo.	....	....	4.30	4.80	....	5.05	....	....	5.90	....	6.30	....	....	....	7.70
Kokomo, Colo.	Durango, Colo.	....	6.00	....	....	6.50	7.20	....	....	....	....	....	....	....	....	....
Telluride, Colo.	Durango, Colo.	....	....	....	....	....	4.30	....	5.00	5.90	6.30	6.30	....	....	....	7.70
Silverton, Colo.	Durango, Colo.	....	....	1.40	1.40	....	....	2.20	....	....	2.30	2.55	....	2.80	....	2.80
Tyrone, N. M.	Douglas, Ariz.	....	....	1.60	1.90	....	2.20	....	2.50	2.80	....	....	3.40	....	....	3.80
Tyrone, N. M.	El Paso, Tex.	....	....	1.60	1.90	....	2.20	....	2.50	2.80	....	....	3.40	....	....	3.80
Lordsburg, N. M.	Douglas, Ariz.	....	1.00	1.30	1.60	....	1.90	....	2.20	2.50	....	....	2.80	....	....	3.40
Lordsburg, N. M.	El Paso, Tex.	....	1.00	1.30	1.60	....	1.90	....	2.20	2.50	....	....	2.80	....	....	3.40
Tombstone, Ariz.	Douglas, Ariz.	....	....	.60	....	.90	....	....	....	1.30	....	....	1.60	....	....	1.90
Tombstone, Ariz.	El Paso, Tex.	....	....	1.90	....	2.50	....	....	....	3.80	....	....	4.40	....	....	4.40
Silver City, N. M.	Douglas, Ariz.	....	....	2.48	....	3.15	....	....	....	3.83	....	....	....	....	....	5.29
Ray Junction, Ariz.	Hayden, Ariz.	....	.10	....	.40	....	.50	....	.80	.90	....	....	1.00	....	....	1.10

(a) Minimum tonnage of 200 tons per day. (b) In open cars, minimum 80,000 lb. ( ) Siliceous ore tailing

Rates on Ores and Concentrates

From	To	Value of Ores and Concentrates $10	$15	$20	$25	$30	$35	$40	$50	$60	$70	$75	$80	$90	$100
		Rate													
Burke, Idaho	Bradley, Idaho	....	....	....	....	....	....	....	....	.68	....	....	....	....	1.02
Burke and Wallace, Idaho	East Helena, Mont.	....	....	....	....	3.00	....	3.25	3.50	3.75	4.00	....	4.25	4.50	4.75
Sagel, Idaho	East Helena, Mont.	....	....	....	3.38	....	3.83*	....	4.16	....	....	....	....	....	4.84
Arizona Tunnel, Idaho	Bradley, Idaho	....	....	....	....	....	....	....	....	.35	....	....	....	....	.50
Bayview, Idaho	Bradley, Idaho	....	....	....	....	....	....	....	3.75	....	....	4.37½	....	....	5.12½
Park City, Utah	Salt Lake Smelters	1.00	1.10	1.25	....	1.50	....	1.75	....	2.00	....	....	2.25	....	2.50
Eureka, Utah	Salt Lake Smelters	1.00	....	1.25	....	1.50	....	1.75	2.00	2.25	2.50	....	2.75	3.00	3.25
Tintic, Utah	Salt Lake Smelters	1.00	....	1.25	....	1.50	....	1.75	2.00	2.25	2.50	....	2.75	3.00	3.25
St. Johns, Utah	Salt Lake Smelters	1.00	....	1.25	....	1.50	....	1.75	2.00	2.25	2.50	....	2.75	3.00	3.25
Ophir, Utah	Salt Lake Smelters	1.00	....	1.25	....	1.50	....	1.75	2.00	2.25	2.50	....	2.75	3.00	3.25
Bingham, Utah	Garfield, Utah	....	.40	....	.75	....	....	....	.95	....	....	1.10	....	....	1.25
Cherry Creek, Nev.	Garfield, Utah ( )	....	....	4.60	....	5.10	....	5.60	6.10	6.60	7.10	....	7.60	8.10	8.60
Cherry Creek, Nev.	Garfield, Utah (b)	....	....	3.20	....	3.90	....	4.60	5.30	6.00	6.70	....	7.40	....	....
Goldfield, Nev.	Salt Lake Smelters	....	....	5.10	....	5.80	....	6.50	7.20	7.90	8.60	....	9.30	10.00	10.70
Battle Mountain, Nev. (a)	Salt Lake Smelters	....	....	3.20	....	3.80	....	4.40	5.00	5.60	6.20	....	6.80	7.40	8.00
Palisade, Nev. (a)	Salt Lake Smelters	....	....	3.20	....	3.80	....	4.40	5.00	5.60	6.20	....	6.80	7.40	8.00
Mina, Nev. (a)	Salt Lake Smelters	....	....	3.60	....	4.30	....	5.00	5.70	6.40	7.10	....	7.80	8.50	9.20
Lovelock, Nev. (a)	Salt Lake Smelters	....	....	3.20	....	3.90	....	4.60	5.30	6.00	6.70	....	7.40	8.10	8.80
Golconda, Nev. (a)	Salt Lake Smelters	....	....	3.20	....	3.90	....	4.60	5.30	6.00	6.70	....	7.40	8.10	8.80
Hazen, Nev. (a)	Salt Lake Smelters	....	....	3.20	....	3.90	....	4.60	5.30	6.00	6.70	....	7.40	8.10	8.80
Tonopah, Nev.	Salt Lake Smelters	....	....	5.10	....	5.80	....	6.50	7.20	7.90	8.60	....	9.30	10.00	10.70
Rogerson, Idaho	Salt Lake Smelters	3.00	....	3.50	....	4.00	....	4.50	5.00	5.50	6.00	....	6.50	7.00	7.50
Georgetown, Colo.	Leadville, Colo.	....	....	3.50	....	3.75	....	4.00	5.00	5.00	5.80	....	5.80	5.80	5.80
Shirley, Colo.	Leadville, Colo.	....	....	2.25	....	2.25	....	2.25	2.25	4.30	4.30	....	4.30	4.30	4.30

(a) Minimum weight, marked capacity of car used, but not less than 80,000 lb. (b) Minimum weight, 80,000 lb. ( ) Minimum weight, 40,000 lb.
*Indicates a change of tariff since last report.

COMPANY REPORTS

United Eastern Mining Co.

Gold; Oatman, Arizona

A report of the operations of the United Eastern Mining Co. for 1922 shows a net income of $129,109.59, as follows:

Values recovered			
Gold	$1,534,287.64		
Silver	41,165.62		
		$1,575,453.26	
Refund of federal income and profits taxes years 1917-1920, inclusive		76,279.49	
Miscellaneous income		28,570.19	
			$1,680,302.94
Deduct			
Cost of mining, milling, general and administrative expenses.			
Mining		$452,120.75	
Development		64,106.85	
Milling		205,635.36	
Labor and incidental expenses		6,899.92	
Marketing		10,711.47	
Taxes		91,380.62	
Casualty reserve		4,990.71	
Superintendence		10,643.68	
Administrative and general		76,201.59	
Miscellaneous		3,281.85	
			925,972.80
Income before providing for depletion, depreciation and 1922 federal income tax			$754,330.14
Deduct			
Depletion		$567,813.76	
Depreciation of plant		57,406.79	
			625,220.55
Net income before providing for 1922 federal income taxes			$129,109.59

Production recovered amounted to 74,221.3 oz. gold and 41,223.2 oz. of silver.

Balance sheet as of Dec. 31, 1922, is as follows:

Assets

Capital assets			
Property at value agreed upon with treasury for depletion			$4,832,467.87
Less depletion			4,210,802.59
			$621,665.28
Plant and betterments (depreciated values)			717,882.59
Investments at cost			
Liberty bonds (par)		$500,200.00	
El Tigre properties		113,350.35	
Apache Powder Co. stock		15,000.00	
			628,550.35
Working and current assets			
Inventories			
Warehouse stock	$88,470.21		
Bullion values in solution	15,696.78	$104,166.99	
Accrued interest		4,475.75	
Accounts receivable			
Bullion shipments	$89,996.99		
Refund of income and profits taxes	51,775.74		
Miscellaneous	1,131.12		
		142,903.85	
Cash in banks and on hand		200,583.84	
			452,130.43
Deferred charges			42,854.36
			$1,841,417.73

Liabilities

Capital stock			
Authorized and issued 1,500,000 shares of $1 each			$1,500,000.00
Less in treasury 137,000 shares of $1 each			137,000.00
Outstanding 1,363,000 shares of $1 each			$1,363,000.00
Capital surplus			
Balance Dec. 31, 1921		$946,529.10	
Adjustment of property values		93,534.57	
		$1,040,063.67	
Distribution to stockholders in excess of net income for the year		688,690.41	351,373.26
Distribution to stockholders	$817,800.00		
Net income after providing for depletion and depreciation as per the annexed account	129,109.59		
	$688,690.41		
Current liabilities			
Accounts and wages payable		$46,927.37	
Provision for general taxes		62,190.04	
Reserve for accidents		17,927.06	
			127,044.47
			$1,841,417.73

Silversmith Mines, Ltd.

Silver Lead; New Denver, B. C.

A report of the operations of Silversmith Mines, Ltd., for the year ended May 31, 1923, shows a gain of $254,366.59 as follows:

Profit-and-Loss Account

Dr.		
Mining in ore		$82,135.80
Mining expense		47,724.66
Development		7,289.00
Milling		86,393.42
Power plant operation		9,383.65
Boarding house loss		1,111.43
Insurance		1,822.67
Royalties		22,166.72
Taxes		25,824.96
Interest		126.02
General expenses		45,970.04
Depreciation		21,951.47
Total expenses		$351,899.84
Depletion	$127,183.29	
Gain for the year	127,183.30	254,366.59
Total		$606,266.43
Cr.		
Received from sales of 5,222½ tons of silver-lead ore and concentrates		$459,218.79
Received from sales of 2,578 tons of zinc concentrates		101,385.49
Actual value of 235½ tons of silver-lead ore and concentrates in transit		20,958.73
Actual value of 112½ tons of zinc concentrates in transit		4,072.32
Estimated value of 195 tons of silver-lead ore and concentrates on hand		19,545.10
Estimated value of 30 tons of zinc concentrates on hand		1,086.00
Total		$606,266.43

Surplus Account, May 31, 1923

Dr.		
Balance June 1, 1922		$67,027.92
Dominion government adjustments of depreciation for prior years		10,065.97
Dominion government adjustments of depletion for prior years		6,319.12
Miscellaneous adjustment		5.57
Gain for the year	$254,366.59	
Less depletion	127,183.29	127,183.30
Total		$210,601.88
Cr.		
Dividends paid		$125,000.00
Balance May 31, 1923		85,601.88
Total		$210,601.88

Balance sheet as of May 31, 1923, follows:

Assets

Property			
Cost of mining property	$330,466.10		
Less depletion of mine through operation	248,951.87		
			$81,514.23
Machinery and equipment	$176,084.78		
Buildings	86,859.78		
Total	$262,944.56		
Less reserve for depreciation	54,800.43		
			208,144.13
Total property			$289,658.36
Current assets			
Cash in banks	$94,347.15		
Total cash in banks	$94,337.15		
Government bonds	50,000.00		
Ore in transit	25,031.05		
Ore on hand	20,631.10		
Total current assets			189,999.30
Prepaid insurance			1,737.90
Total assets			$481,395.56

Liabilities

Capital stock		
Preferred		
Authorized	$250,000.00	
In treasury, unissued	250,000.00	
Common		
Authorized	$500,000.00	
Assessments not called	125,000.00	
Outstanding—paid up to 15c		$375,000.00

LIABILITIES (Continued)

Current liabilities		
Accounts payable	$6,074.00	
Wages payable	6,801.13	
Accrued taxes	2,100.00	
Accrued royalties	5,818.55	
Total current liabilities		20,793.68
Surplus account (free)		85,601.88
Total liabilities		$481,395.56

The new mill was operated full time from June 1, 1922, to May 31, 1923. Total hours of operation were 8,136; lost on account of no power due to snowslides and other incidental impediments to operation was 213 hours; for repairs, adjustment of belts, and like causes, 154 hours; actual number of mill-shifts operated, 1,017.

	Tons
Feed sent to the mill	35,075
Clean ore taken from picking belt	232
Total feed actually milled	34,843

Average assay of mill feed: Silver, 24.02 oz.; lead, 8.92 per cent; zinc, 7.60 per cent.

While operating during the fiscal year, 522 tons of crude lead and 5,131 tons of silver-lead ore and concentrates and 2,720 tons of silver-zinc concentrates were produced. Shipments during the fiscal year amounted to 5,222 tons of silver-lead ore and concentrates and 2,578 tons of silver-zinc concentrates.

The average price received for silver by the company was 67c. per ounce for 95 per cent of the silver contained in the ore, against 99c., which mines in the United States received, and the average price received for lead was about 0.039c. per pound for 90 per cent of the lead contents, against the price which mines in the United States received of 0.062c. per lb. The metal contents of the ore shipped were as follows: 703,809 oz. of silver, 5,622,705 lb. of lead, and 3,584,261 lb. of zinc.

United Verde Extension Mining Co.

Copper; Jerome, Arizona

A report of the United Verde Extension Mining Co. states that the output for the first quarter of the year was 9,924,880 lb. of copper. The No. 1 reverberatory furnace went down for extensive repairs on the first day of June and during June the blast furnace only was in operation. The No. 1 reverberatory was expected to be in normal operation again by Aug. 1.

The company's copper is well sold up at an average for the months of April, May, and June of slightly over 15c. per lb. The price, however, has softened and market conditions may prevent the payment of a November dividend at the rate of the present one. On the 800 level, the company has encountered toward the west about 60 ft. of excellent ore, which, however, is not yet blocked out. On the 1,500 level, the ore to the north has cut out and the body does not extend northward as far as expected.

No ore has been found in Jerome Verde ground, although about 1,000 ft. of development work has been done since the last report.

Cash on hand July 2, 1923	$1,697,181.77
Liberty Bonds, par value $3,363,950—market value	3,308,542.17
U. S. Treasury Certificates	200,000.00

The Board of Directors, at a meeting on June 11, 1923, declared a dividend of $1 per share, payable on Aug. 1, 1923, to stockholders of record at the close of business July 5, 1923.

The New Jersey Zinc Co.

A statement of operations of The New Jersey Zinc Co. for the quarter ended June 30, 1923, follows:

Income (including dividends from subsidiary companies) after deductions for expenses, taxes, maintenance and repairs, depreciation, depletion and contingencies		$2,117,010.23
Deduct interest on first-mortgage bonds		40,000.00
Net income		$2,077,010.23
Deduct dividends		
2 per cent extra payable July 10, 1923	$979,632.00	
2 per cent quarterly payable Aug. 10, 1923	979,632.00	1,959,264.00
Surplus for the quarter		$117,746.23

Shattuck Arizona Copper Co.

Copper and Lead; Bisbee, Arizona

The following is a report of the results of operations of the Shattuck Arizona Copper Co. for the quarter ended June 30, 1923:

Preparations were begun Feb. 9, 1923, to reopen the mine, and actual repair work was started about the twentieth of February. Shipments of lead to the El Paso smelter and of siliceous ore to the Douglas smelter began on March 7 and 10, respectively. The first shipment of copper ore was made to the Douglas smelter on April 1, 1923, and continued at the rate of 50 tons per day until April 27, when shipments of 100 tons per day began and have continued up to date. Shipments of lead ore to El Paso during the quarter were at the rate of 100 tons per day until June 27, when lead shipments were discontinued pending arrangements with the smelter as to smelting rates and tonnage, and with the railroad as to freight rates. The shipments of siliceous ore, which began on March 10, continued at the rate of 50 tons per day until May 15, when they were discontinued.

The repairing on the surface, and especially underground, has been exceptionally heavy up to the end of the quarter, June 30. The surface has been put in good condition and the working drifts and crosscuts on levels 100 to 600, inclusive, have been cleaned up, but the old stopes are not yet in condition to produce ore, except the copper stopes on the 100- and 200-ft. levels and the lead territory on the 300- and 400-ft. levels.

All of the copper ore stoped during the quarter was taken from old 3 stope on the 100-ft. level, and the new orebody found just before the closing of the mine in 1921, known as 20 stope on the 600-ft. level, with some ore from prospects on the 500-, 600- and 700-ft. levels, started on stringers since the reopening. Prospect 156 out of 18 crosscut, 500-ft. level, has developed some ore carrying good value both in copper and silver, and this showing is promising for a new orebody of size. The ore discovered on the 600-ft. level, which has been stoped as 20 stope 600 and 151 Prospect 700, is a find in new territory.

The company has been handicapped by a shortage of good workmen, especially of skilled miners, which will probably continue until this fall.

The total development during the quarter was 377½ ft., as follows:

	Feet
Drifts, crosscuts and intermediates	271.5
Raises	106

The production for the second quarter of the year was as follows:

	Copper	Lead and Siliceous
Dry tons mined	6,873.163	7,719.924
Dry tons treated	6,697.938	5,366.566
Pounds metal produced	825,502	621,596
Ounces gold produced	309.59	470.87
Ounces silver produced	39,581	94,818
Net operating cost per pound	6.457c.	4.203c.

The net operating cost of 6.457c. per lb. for copper and 4.203c. per lb. for lead is after crediting gold and silver but before depreciation, depletion, or deferred development expense.

The results in earnings for the second quarter of 1923 were as follows:

Copper bullion, at 14½c. per lb		$119,697.79
Gold and silver, at market		38,992.35
Lead settlements from smelter		149,319.28
Interest		8,413.04
		$316,42.246
Operating expense, copper	$92,300.97	
Operating expense, lead and silica	119,894.27	
Administrative expense	7,592.43	219,787.67
Net income, plus depreciation, depletion and deferred development		$96,634.79

The lead and silica settlements are the amounts received from the smelter; the silver in copper ore is actual market up to the end of the Pittman Act and 60c. per oz. thereafter; the gold in copper ore is at actual market.

MINING STOCKS

Week Ended July 28, 1923

Stock	Exch.	High	Low	Last		Last Div.
COPPER						
Ahmeek	Boston	61	59	60	June 23, Q	$1.50
Alaska-Br. Col.	N. Y. Curb	...	...	1½	...	...
Alloues	Boston	*17½	*17	*17½	Mar. '19	1.00
Anaconda	New York	40⅝	38⅞	39⅜	Je. 16, Jy. 23	0.75
Arcadian Consol.	Boston	1⅞	1⅞	1⅞	...	...
Ariz. Com'l.	Boston	10¼	9¼	9¼	July '23,	0.50
Calaveras	N. Y. Curb	2	2	2	...	...
Calumet & Arizona	Boston	48	46½	46⅝	June '23,	1.00
Cal. & Hecla (New)	Boston	43½	42	42½	June '23, Q	10.00
Centennial	Boston	8¾	8½	8½	Dec. '18, SA	1.00
Cerro de Pasco	New York	39	36⅝	37¼	Jy. 19, Au. 1	1.00
Chile Copper	New York	26½	26	26⅛	Se. 1, Se. 29, Q	0.62½
Chino	New York	18½	17½	17½	Sept. '20, Q	0.37½
Con. Coppermines	N. Y. Curb	2½	1 13/16	1⅞	...	...
Copper Range	Boston	31	28½	29	May '23, Q	1.00
Crystal Copper	Boston Curb	*64	*55	*57	...	...
Davis-Daly	Boston	2¼	2⅛	2⅛	Mar. '20, Q	0.25
East Butte	Boston	6	5⅜	5⅜	Dec. '19, A	0.50
First National	Boston Curb	31	31	31	Feb. '19, SA	0.15
Franklin	Boston	1¼	1⅛	1⅛	...	...
Gadsden Copper	Boston Curb	55	45	45	...	...
Granby Consol.	New York	17⅜	17	17¼	May '19, Q	1.25
Greene-Cananea	New York	17⅛	16	16	Nov. '20, Q	0.50
Hancock	Boston	...	...	2½	...	...
Howe Sound	N. Y. Curb	3⅛	3	3⅛	Jy. 2, Jy. 16	0.05
Inspiration Consol.	New York	28⅜	27	27⅝	Je. 14, Jy. 2 Q	0.50
Iron Cap	Boston Curb	4	4	4	May 23, K	0.15
Isle Royale	Boston	21½	20	21½	June '23, Q	0.50
Kennecott	New York	34½	32½	33⅛	Je. 8, Jy. 2 Q	0.75
Keweenaw	Boston	80	80	80	...	...
Lake Copper	Boston	2	1⅞	1⅞	...	...
Magma Copper	New York	30½	28⅞	29	Jan. '19, Q	0.50
Mason Valley	N. Y. Curb	1⅝	1½	1½	...	...
Mass Consolidated	Boston	1⅜	1⅜	1⅜	Nov. '17, Q	1.00
Miami Copper	New York	23½	22½	23	Au. 1, Au 15, Q	0.50
Michigan	Boston	2	1⅞	1⅞	...	...
Mohawk	Boston	43	41⅞	42	June '23, Q	1.00
Mother Lode Coa.	New York	9¼	8⅞	9	Je. 8, Je. 30, Q	0.50
Nevada Consol.	New York	11⅝	11⅜	11⅞	Sept. '20, Q	0.25
New Cornelia	Boston	18	17⅞	17⅞	Au. 3, Au, 20, Q	0.25
North Butte	Boston	2½	2⅜	2½	Oct. '18, Q	0.25
Ohio Copper	N. Y. Curb	*70	*60	*70	...	...
Old Dominion	Boston	18½	18	18½	Dec. '18, Q	1.00
Osceola	Boston	31½	28⅛	31⅜	June '23, Q	1.00
Phelps Dodge	Open Mar.	†165	†155	....	Je. 20, Jy. 2 Q	1.00
Quincy	Boston	27	26	27	Mar. '20, Q	1.00
Ray Consolidated	New York	10⅝	10	10⅛	Dec. '20, Q	0.25
Ray Hercules	N. Y. Curb	1	*80	*87	...	...
St. Mary's Min. Ld.	Boston	34	33	34	Mar. '23, K	3.00
Seneca Copper	New York	8	7⅛	7⅞	...	...
Shannon	Boston	*55	*55	*55	Nov. '17, Q	0.25
Shattuck Arizona	New York	6¼	6¼	6¼	Jan. '20, Q	0.25
South Lake	Boston	...	...	*12	...	...
Superior & Boston	Boston	*98	*90	*98	...	...
Tenn. C. & C. cfs.	New York	9	8⅛	8⅛	Je. 30, Jy. 16, Q	0.25
Tuolumne	Boston	...	...	*14½	May '13,	0.10
United Verde Ex.	N. Y. Curb	30½	29½	29½	Jy. 5, Au. 7, Q	1.00
Utah Consol.	Boston	1⅜	1⅜	1⅜	Sept '18,	0.25
Utah Copper	New York	58⅝	57⅜	58⅜	Je. 8, Je. 30, Q	1.00
Utah Metal & T.	Boston	*60	*55	*60	Dec. '17,	0.30
Victoria	Boston	*75	*75	*75	...	...
Winona	Boston	*65	*65	*65	...	...
Wolverine	Boston	7	6¾	7	...	...
NICKEL-COPPER						
Internat. Nickel	New York	12⅜	12	12	Mar.' 19,	0.50
Internat. Nickel pfd.	New York	79¼	79¼	79¼	Jy. 19, Au. 1	1.50
LEAD						
Carnegie Lead & Zinc	Pittsburgh	...	...	3	...	...
National Lead	New York	113	110½	112½	Se. 16, Se. 29 Q	2.00
National Lead pfd.	New York	...	...	111½	Au. 24, Se. 15 Q	1.75
St. Joseph Lead	New York	18	17⅛	17⅛	Se. 9, Se. 20 Q, X	0.50
ZINC						
Am. Z. L. & S.	New York	9¼	9	9	May '20,	1.00
Am. Z. L. & S. pfd.	New York	32	32	32	Nov. '20, Q	1.50
Butte C. & Z.	New York	6¼	5⅜	5⅜	Mar. '23,	0.50
Butte & Superior	New York	19¾	18½	18⅜	Je. 15, Je. 30, Q	0.50
Callahan Zn-Ld	New York	6	5⅜	5⅜	Dec. '20, Q	0.50
New Jersey Zn.	N. Y. Curb	150⅛	150	150	Jy 31, Au. 10 Q	2.00
United Zinc	N. Y. Curb	...	...	*80	...	...
Yellow Pine	Los Angeles	...	...	*60	June '23, Q	0.03
SILVER						
Alvarado	N. Y. Curb	3¼	3¼	3¼	...	...
Batopilas Mining	New York	⅛	⅛	⅛	Dec. '07, I	0.12½
Beaver Consol.	Toronto	*33½	*33	*33	May '20, K	0.03
Candelaria	N Y. Curb	*7	*6	*6	...	...
Castle-Trethewey	Toronto	*26¼	*25	*25	...	...
Coniagas	Toronto	3.00	2.65	2.70	May '21, Q	0.12½
Crown Reserve	Toronto	*60	*59	*60	Jan. '17,	0.05
Hilltop-Nev.	N. Y. Curb.	*25	*11	*22	...	...
Kerr Lake	N. Y. Curb	2⅜	2⅜	2⅜	Jy. 2, Jy. 16, Q	0.12½
La Rose	Toronto	*32	*32	*32	Apr. '22,	0.10
McKinley-Dar.-Sav.	Toronto	*17½	*17	*17½	Oct. '20, Q	0.03
Mining Corp. Can.	Toronto	2.50	2.14	2.40	Sept. '20, Q	0.12½
Nipissing	N. Y. Curb	5¼	5¼	5¼	Jy. 1, Jy. 20 Q	0.15
Ontario Silver	New York	3¼	3⅛	3⅛	Jan. '19, Q	0.50
Temiskaming	Toronto	*38	*38	*38	Jan. '20, K	0.04

Stock	Exch.	High	Low	Last		Last Div
GOLD						
Alaska Gold	New York	⅜	⅛	⅛	...	...
Alaska Juneau	New York	1	⅞	1	...	...
Boundary Red M.	N. Y. Curb	...	...	*15	...	...
Carson Hill	Boston	5⅜	5⅛	5⅛	...	...
Cresson Consol. G.	N. Y. Curb	3⅛	3⅛	3⅛	Apr. '23 Q	0.10
Dome Mines	New York	35½	34	34	Je. 30, Jy. 20 Q	1.00
Golden Cycle	Colo. Springs	...	...	1.07	Dec. '22, Q	0.02
Hollinger Consol.	Toronto	12.50	11.80	12.50	Jy. 26, Au. 13 M	0.05
Homestake Mining	New York	62	62	62	Jy. 20, Jy. 25 M	0.50
Kirkland Lake	Toronto	*34	*34	*34	...	...
Lake Shore	Toronto	3.50	3.40	3.40	Au. 1 Au. 15 '23, Q	0.02
McIntyre-Porcupine	New York	16½	16	16⅛	Au. 1, Se. 1, Q	0.25
Portland	Colo. Springs	...	...	*35	Oct. '20, Q	0.01
Teck-Hughes	N. Y. Curb	1 1/16	1⅛	1⅛	...	...
Tom Reed	Los Angeles	*45	*43½	*43½	Dec. '19,	0.02
United Eastern	N. Y. Curb	1⅛	1⅛	1⅛	Jy. '28, Q	0.15
Vipond Cons.	Toronto	*67	*65	*66	...	...
Wright-Hargreaves	Toronto	3.10	3.05	3.05	Apr. '23,	0.02½
Yukon Gold	N. Y. Curb	1⅛	1⅛	1⅛	June '18,	0.02½
GOLD AND SILVER						
Boston-Mont. Corp.	N. Y. Curb	...	...	*14	...	...
Con. Cortez	N. Y. Curb	*68	*66	*68	...	...
Con. Virginia	San Francisco	9⅛	8½	8½	...	...
Continental Mines	N. Y. Curb	4⅛	4⅛	4⅛	...	...
Dolores Esperanza	N. Y. Curb	1 1/16	1 1/16	1 1/16	Jy. 1, Jy. 10 Q	0.05
Jib Consol.	N. Y. Curb	*70	*70	*70	...	...
Tonopah Belmont	N. Y. Curb	*69	*67	*68	Apr. '23, Q	0.05
Tonopah Divide	N. Y. Curb	*53	*50	*53	May 23	0.10
Tonopah Extension	N. Y. Curb	1⅞	1⅞	1⅞	Je. 9, Jy. 2	0.05
Tonopah Mining	N. Y. Curb	1 1/16	1 1/16	1 1/16	Apr. '23, Q	0.07½
Unity Gold	N. Y. Curb	3¼	3⅛	3⅛	...	...
West End Consol.	N. Y. Curb	*1	*1	*1	Mar. '23, Q	0.05
SILVER-LEAD						
Bingham Mines	Boston	...	...	16	Sept. 19, Q	0.25
Cardiff M. & M.	Salt Lake	*55	*55	*55	Dec. '20,	0.15
Chief Consol.	Boston Curb	3⅜	3⅛	3⅜	Au. 1, '23, Q	0.10
Columbus Rexall	Salt Lake	*42⅜	*39½	*42½	Aug. '22,	0.03
Consol. M. & S.	Montreal	...	...	25	Oct. '20, Q	0.62½
Erupcion	Boston Curb	3	2⅞	3	Apr. '23, Q	0.125
Federal M. & S.	New York	...	...	8	Jan. '09,	1.50
Federal M. & S. pfd.	New York	38	36	38	June '23, Q	1.75
Florence Silver	Spokane	26½	25½	26½	Apr. '19, Q, X	0.01½
Hecla Mining	N. Y. Curb	7⅛	7	7	Je. 15 Q	0.50
Iron Blossom Con.	N. Y. Curb	*23	*23	*23	July 16,	0.02½
Marsh Mines	N. Y. Curb	*7	*7	*7	June '21, I	0.02
Park City	Salt Lake	....	....	3.25	Je. 15, Jy. 2 Q	0.12½
Park Utah	N. Y. Curb	...	...	2⅜	Je. 15, Jy. 2 Q	0.15
Prince Consol.	Salt Lake	*1⅛	*1	*1⅛	Nov. '17,	0.02½
Silversmith	Spokane	*35	*34	*34	Jy. 2, Jy. 10	0.02
Simon Silver-Lead	N. Y. Curb	*26	*26	*26	...	...
Snowstorm Silver-L.	N. Y. Curb	...	...	*43	...	...
Tamarack-Custer	Spokane	1.2	1.20	1.20	Je. 30, K	0.02
Tintic Standard	Salt Lake	2.95	2.92½	2.92½	July '23	0.15
Utah-Apex	Boston	3⅛	3⅛	3⅛	June '23, Q, X	0.50
IRON						
Bethlehem Steel	New York	48½	45½	46½	Se. 1, Oc. 1 Q	1.25
Char. Iron	Detroit	⅞	⅞	⅞	...	...
Char. Iron pfd.	Detroit	...	...	1¾	...	...
Colorado Fuel & Iron	New York	26½	25	26	Au. 10, Au. '25 Q	2.00
Col. Fuel & Iron pfd.	New York	...	...	102	Feb. '23, Q	2.00
Gt. North'n Iron Ore	New York	27	25⅜	26	Apr. '23	1.00
Inland Steel	N. Y. Curb	...	...	46¼	Au. 15 Se. 1 '23 Q	0.62½
Mesabi Iron	N. Y. Curb	...	...	7	...	...
Replogle Steel	New York	11⅛	10⅜	10⅜	...	...
Republic I. & S.	New York	44⅞	41⅛	43	May '21	1.50
Republic I. S. pfd.	New York	92½	92	92	Se. 15, Oc. 1 Q	3.75
Sloss-Sheffield S. & I.	New York	43	41¼	42	Feb. '21	1.50
Sloss-Shef. S. & I. pfd.	New York	...	...	78	Je. 22, Jy. 2 Q	1.75
U. S. Steel	New York	88½	85½	86½	Au. 30, Se. 29, Q	1.25
U. S. Steel pfd.	New York	118	117¾	118	Au. 7, Au. 30 Q	1.75
Virginia I. C. & C.	New York	55	52	52	Je. 16, Jy. 2	2.00
Virginia I.C.&C.pfd.	New York	...	...	78¼	Je. 16, Jy. 2	2.50
VANADIUM						
Vanadium Corp.	New York	29	26	27½	Jan. '21, Q	1.00
ASBESTOS						
Asbestos Corp.	Montreal	51½	47	47	Je. 30, Jy. 15 Q	1.50
Asbestos Corp. pfd.	Montreal	...	...	75	Je. 30, Jy. 15 Q	1.75
SULPHUR						
Freeport Texas	New York	11⅜	10¼	10¾	Nov. '19, Q	1.00
Texas Gulf	New York	57⅞	55⅜	56½	June '23, Q	1.50
PLATINUM						
So. Am. Gold & P.	N. Y. Curb	3½	3⅜	3½	...	...
MINING, SMELTING AND REFINING						
Amer. Metal	New York	42⅜	42⅛	42⅛	Au. 20, Se. 1	0.75
Amer. Metal pfd.	New York	...	...	110	Au. 18, Se 1	1.75
Amer. Sm. & Ref.	New York	55⅞	53¾	54½	Jy. 9, Au. 1	1.25
Amer. Sm. & Ref. pfd	New York	95⅞	95½	95½	Au. 10, Se. 1 Q	1.75
U. S. Sm. R. & M.	New York	23½	21⅝	23⅛	Jan. '21, Q	0 50
U.S. Sm.R.& M. pfd.	New York	....	....	41½	Jy. 6, Jy. 14 Q	0.87½

*Cents per share. †Bid or asked. Q, Quarterly. SA, Semi-annually. M, Monthly. K, Irregular. I, Initial. X, Includes extra.

Toronto quotations courtesy Arthur E. Moysey; Spokane, Pohlman Investment Co.; Salt Lake, Stock and Mining Exchange; Los Angeles, Chamber of Mines and Oil; Colorado Springs, Colorado Springs Stock Exchange.

Current Prices of Mine Materials and Supplies

RISE AND FALL OF THE MARKET

Declines—Steel structurals declined 10c. in Dallas and 35c. per 100 lb. in San Francisco, during month. Plates and structurals, however, holding firmly at $2.50 per 100 lb., Pittsburgh. Yellow pine timbers dropped $2 in Chicago and from $3 to $5 per M. ft. in Birmingham, since the middle of July. Wire nails lower in San Francisco; both wire and cut, in St. Louis. Raw linseed oil quoted at $1.05, f.o.b. New York, against $1.10; and at $1.14 in Chicago, compared with $1.28 per gal. (5 bbl. lots) one month ago. Manila rope declined in Atlanta and dynamite in Minneapolis.

Advances—Black steel sheets advanced 20c. and galvanized, 25c. per 100 lb. in Chicago. Denver reports rise of $1 in fir, hemlock and spruce timbers; Minneapolis, $1 in fir and Kansas City, 50c. per M. ft. in both fir and hemlock. Common lump lime higher in San Francisco.

SHEETS—Quotations are per 100 lb. in various cities from warehouse also the base quotations from mill:

Blue Annealed	Pittsburgh, Large Mill Lots	St. Louis	Chicago	San Francisco	New York
No. 10	$3.00	$4.45	$4.15	$5.10	$4.59
Black No. 28	3.85	5.20	5.20	6.15	5.15
Galvanized No. 28	5.00	6.35	6.35	6.50	6.15

STEEL RAILS—The following quotations are per ton f.o.b. Pittsburgh and Chicago for carload or larger lots:

	Pittsburgh Current	Pittsburgh One Year Ago	Birmingham	Chicago
Standard bessemer rails	$43.00	$40.00	.....	$43.00
Standard openhearth rails	43.00	40.00	$43.00	43.00

TRACK SUPPLIES—The following prices are base per 100 lb. f.o.b. Pittsburgh for carload lots, together with the warehouse prices at the places named:

	Pittsburgh Current	Pittsburgh One Year Ago	Chicago	St. Louis	San Francisco	Birmingham
Standard spikes, ⅝-in. and larger	$3.15	$2.25@2.35	$3.00	$4.00	$5.00	$3.75
Track bolts	4.00@4.25	3.00@3.50	4.00	5.00	6.20	4.70
Standard section angle bars	2.75	2.40	2.75	4.00	4.25	3.10

STRUCTURAL MATERIAL—Following are base prices f.o.b. mill, Pittsburgh and Birmingham together with quotations per 100 lb. from warehouses at places named:

	Pittsburgh, Mill	Birmingham Mill	New York	Dallas	St. Louis	Chicago	San Francisco
Beams, 3 to 15 in.	$2.50	$2.75	$3.64	$4.20	$3.45	$3.40	$3.60
Channel, 3 to 15 in.	2.50	2.75	3.64	4.20	3.45	3.40	3.60
Angles, 3 to 6 in., ¼ in. thick	2.50	2.75	3.64	4.20	3.45	3.40	3.60
Tees, 3 in. and larger	2.50	2.75	3.64	4.20	3.50	3.40	3.60
Plates	2.50	2.75	3.64	4.30	3.45	3.40	3.60

WIRE ROPE—Discounts from list price, f.o.b. New York and east of Missouri River, on regular grades of bright and galvanized are as follows:

Hercules red strand, all constructions	20%
Cast steel round strand rope	20%
Galvanized steel rigging and guy rope	7½%
Round strand iron and iron tiller	5%
Plow steel round strand rope	35%
Special steel round strand rope	30%

	New York	Cleveland	Chicago
Drill Rod (from list)	55%	40@55%	50%

WROUGHT PIPE—The following discounts are to jobbers for carload lots on the latest Pittsburgh basing card:

	Steel Inches	Steel Black	Steel Galv.	Iron Inches	Iron Black	Iron Galv.
BUTT WELD—	⅛ to 3	62	50½	⅛ to 1¼	30	13
LAP WELD—	2½ to 6	59	47½	2½ to 4	26	11

STEEL PIPE—From warehouses at the places named the following discounts hold for steel pipe:

	Black New York	Black Chicago	Black St. Louis
2½ to 6 in. lap welded	44%	47%	46%

CAST-IRON PIPE—The following are prices per net ton for carload lots:

	New York Current	New York One Year Ago	Birmingham	Chicago	St. Louis	San Francisco
6 in. and over	$62.30	$53.30	$49.00	$60.20	$57.60	$62.00

Nuts—	New York	Cleveland	Chicago
Hot pressed, sq., per 100 lb. Off list	List net	$2.75	$2.50
Cold punched, sq., per 100 lb. Off list	List net	2.75	2.50

HOLLOW TILE—Price per block in carload lots to contractor for hollow building tile.

	New York Current on Trucks	New York One Year Ago	Chicago	Philadelphia	St. Louis	San Francisco	Perth Amboy N. J., Factory
4x12x12	$0.1573	$0.1112	$0.0724	.....	$0.092	$0.108	.....
6x12x12	.2097	.1667	.0996	.....	.126	.156	.....
8x12x12	.2621	.2084	.1358	.....	.170	.244	$0.2691

MACHINE BOLTS—

	New York	Cleveland	Chicago
1½ and 1¼x3 in. up to 12 in.	15 %	50%	50%

LUMBER—Prices of rough Douglas Fir No. 1 common, in carload lots to dealers in yards at San Francisco. To contractors, $2 per M. ft. additional.

	6-8 and 12 Ft.	10-16-18 and 20 Ft.	22 and 24 Ft.	25 to 32 Ft.
3x3 and 4	$40.00	$41.00	$42.00	$45.00
3x6 and 8	40.00	41.00	42.00	45.00
4x4-6 and 8	40.00	41.00	42.00	45.00

Wholesale prices to dealers of long leaf yellow pine. To contractors in New York City, delivered from lighters or cars to job, $5 additional.

	New York 20 Ft. and Under	New York 22-24 Ft.	Chicago 20 Ft. and Under	Chicago 22-24 Ft.
3x4 to 8x8	$50.00	$51.00	$50.50	$52.50
3x10 to 10x10	54.00	55.00	53.50	55.50
3x12 to 12x12	58.00	59.00	56.50	58.50

Other Cities	8 x 8-In. x 20 Ft. and Under Pine	Fir	Hemlock	Spruce	12 x 12-In. 20 Ft. and Under Pine	Fir
Boston	$68.00	.....	$65.00	$57.00	$90.00	.....
Cincinnati	40.00	$75.00	75.00	90.00	44.00	$80.00
Denver	40.75	41.75	41.75	41.75	.....	42.75
Minneapolis	43.50	42.50	41.50	.....	46.00	44.75
Kansas City	44.25	47.00	47.00	.....	57.25	49.00
Birmingham	30@35	.....	.....	.....	40@45	.....

NAILS—The following quotations are per keg from warehouse:

	Pittsburgh, Mill	Chicago	San Francisco	Dallas	St. Louis	Montreal
Wire	$3.00	$3.45	$4.20	$4.25	$3.34	$4.95
Cut	....	5.50	5.80	5.75	3.64	5.00

PORTLAND CEMENT—Prices to contractors per bbl. in carload lots *without bags*. Cash discount not deducted.

	Current	One Month Ago	One Year Ago
NewYork, del. by truck	$2.70@2.80	$2.70@2.80	$2.40@2.50
Chicago, f.o.b.	2.20	2.20	2.05
Cleveland, f.o.b.	2.46	2.46	2.31

LIME—Warehouse prices:

	Hydrated, per Ton Finishing	Hydrated, per Ton Common	Lump, per Barrel Finishing	Lump, per Barrel 280-lb. net Common
New York	$18.20	$13.10	$3.75	$3.00@$3.25
San Francisco	22.00	.....	....	(180-lb net) 2.10

LINSEED OIL—These prices are per gallon:

	New York Current	New York One Year Ago	Chicago Current	Chicago One Year Ago
Raw in barrel (5 bbl. lots)	$1.05	$0.91	$1.14	$1.01

WHITE AND RED LEAD—In 100-lb. kegs, base price in cents per pound:

	Dry Current	Dry 1 Yr. Ago	In Oil Current	In Oil 1 Yr. Ago
Red	14.00	12.50	15.50	14.00
White	14.00	12.50	14.00	12.50

HOSE—

Fire	50-Ft. Lengths
Underwriters' 2½-in. coupled	58c per ft.

Air	First Grade	Second Grade
¾-in., per ft.	3 ply $0.35½	4 ply $0.26½

Steam—Discounts from List

First grade..... 40% Second grade....40–5% Third grade.... 40–10%

RUBBER BELTING—The following discounts from list apply to transmission rubber and duck belting:

Competition..... 60% Best grade..... 50–10%

LEATHER BELTING—List price, 2c. per sq. in. per ply.

Grade	Discount from list
Medium	30–10%
Heavy	20–5–2½%

RAWHIDE LACING—For cut, best grade, 40%, 2nd grade, 50%. For laces in sides, best, 48c. per sq.ft.; 2nd, 43c. Semi-tanned: cut, 40%; sides, 48c. per sq.ft.

PACKING—Prices per pound:

Rubber and duck for low-pressure steam, ¾ in.	$0.90
Rubber sheet	.45
Rubber sheet. wire insertion	.70

MANILA ROPE—Per lb., ¾-in. and larger, 1,200-ft. coils.

Atlanta	$0.21	New Orleans	$0.18½
New York	.18½	Seattle	.18
Chicago	.18	San Francisco	.18

EXPLOSIVES—Prices per pound of dynamite in small lots:

	Gelatin 40%	Gelatin 60%
New York	$0.27	$0.295
Minneapolis	.1917	.2123
Denver	.2025	.2275
Seattle	.165	.19
Cincinnati	.225	.25
New Orleans	.195	.220
San Francisco	.1625	.1925

FLOTATION OILS—All prices are per gal. in carload lots; 50-gal. bbls., gross weight 500 lbs.

Pine oil, steam dist., f.o.b. New York	$0.70
Pine oil, pure, dest. dist. f.o.b. New York	.65
Pine tar oil, ref. f.o.b. New York	.48
Pine tar oil, crude, tank cars f.o.b. Jacksonville, Fla.	.32½

CHEMICALS—

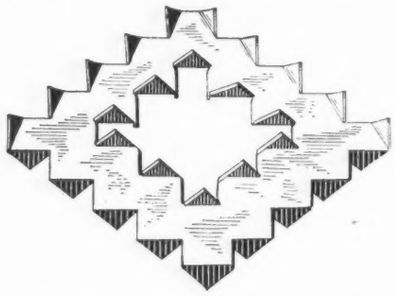
Zinc dust, 550 lb. casks, f.o.b. Palmerton, Pa., per lb.	$0.09½
Litharge, delivered New York, casks, 500 lb. lots, per 100 lb.	12.60
Sodium cyanide, 220 lb. single case lots, f.o.b. New York, per lb.	.25

NEW MACHINERY AND INVENTIONS

A New Timber Joint Connection

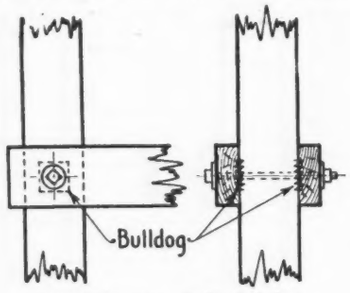
Plate of Cold-Rolled Steel With Projecting Teeth Convenient for Reinforcement

The device illustrated in the accompanying cuts saves labor and time in making timber connections, and provides a firm and efficient joint. It consists of a special cold-rolled steel plate (made in 1½-, 3-, 4-, and 5-in. sizes) with evenly spaced teeth project-



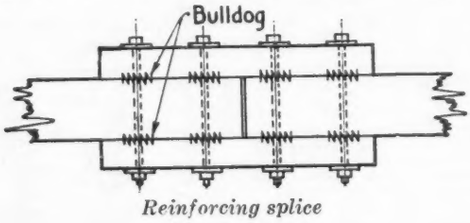
Timber joint connection of cold-rolled steel

ing about ⅜-in. on both sides. Joint connections are made by boring holes in the wooden members to be connected, and placing the "bull dogs" over the holes and between the members. Long standard bolts with cold-rolled steel washers are used to pull the members



Reinforcing bolted joint

together, forcing the teeth into the wood. The joint thus made is firm, efficient, and tight, even where the wood shrinks. The device does not tend to split the wood. Timber connections of



Reinforcing splice

every kind, it is claimed, can be quickly made. The device is being used in coal and metal mines for timber work. It is made by the Midwest Steel & Supply Co., 28 West 44th St., New York.

INDUSTRIAL NOTES

A review of thirty years history of the General Electric Company from its foundation in 1892 to 1922, is made the subject of an interesting 34-page booklet just issued to the company's stockholders. Tracing the development of the electrical art which grew out of the early pioneering work of the Edison General Electric Co., and the Thomson-Houston Electric Co., the astonishing growth of the business, the rapid increase in the size of generating units, steam turbines and the ever widening application of electric power and human speeds is pictured. Twenty-three illustrations of electrical progress and progress in industrial relations add further interest to the text which follows the course of the company's activity by citing milestones of electrical development for which it was so largely responsible. The following headings give an idea of what the book contains: "Large Scale Power Generation," "Power on the Sea," The Trackless Trolley," "At the Panama Canal," "Contributions to Long Distance Wireless Communication," "Lightening Home Burdens," "Far Reaching Aid to Medical Science," "Progress in Illumination," "A Great Necessity at a Small Expense," "One Million Volts," "Prices Increased Less Than the Average," "How G-E Money is Spent," "Opportunities for the Future."

The Hisey-Wolf Machine Co., Cincinnati, Ohio, has issued a two-page bulletin No. 3014-S describing a new, direct, motor-driven combination grinding and buffing machine. This is a 1-hp. machine that can be supplied for various voltages for alternating current and for direct current.

The Layne & Bowler Co., Memphis, Tenn., has prepared a new bulletin discussing the subject of guaranteed water supply, in which it contracts with a municipality or industry to furnish them with a specific quantity of water for a certain price. It also describes the Layne gravel wall pumps and the Layne deep-well centrifugal pump.

About fifty American manufacturers of fine precision instruments of various types all the way from high pressure gages to ultrafine chemical balances, will show their goods at this year's Chemical Exposition in New York, according to early estimates. More than an equal number of manufacturers of all kinds of chemical and allied plant equipment such as centrifugals, screens, crushing machinery, pumps, acid-proof ware, valves, gears, pipes, drying equipment, filter presses and the like, will also have displays.

The Vulcan Iron Works, Wilkes-Barre, Pa., announces that it has made a change in representation at its New York office, in the Hudson Terminal Building, 50 Church St. M. E. Davis, who has had charge of this office for us for a number of years past, has resigned, and Thomas MacLachlan, of the home office, has been made manager of the New York office. Mr. MacLachlan will handle inquiries not only for locomotives and steel castings, but all of the other lines. The company makes such as electric hoists and mining machinery, cement kilns, coolers and dryers.

The El Paso office of the Howe Sound Co., the Britannia Mining & Smelting Co., Ltd., and the El Potosi Mining Co. was discontinued Aug. 1, 1923. From that date the address of Wm. J. Quigly, president, will be 730 Fifth Ave., New York City.

Brenner-Moxley-Mervis Co. is the name of an enterprise which has been financed entirely by Chicago capital. The company will engage in the production of copper rods and drawn copper wire for electrical and power transmission and eventually in the production of various allied products as well. At the outset, however, it will confine itself to the production of copper rods and wire. The company has a paid-in capitalization of $600,000 and has acquired an eight-acre tract of ground in Chicago, where it now has under construction the first unit of a plant which will eventually cover nearly the whole of the eight acres. This unit, which is being erected at a cost of more than half a million dollars, will have a frontage on Kedzie Avenue of 116 ft. and a depth of 388 ft. and will be one of the most modern and have a greater capacity than any plant of its kind in the country. It will consume approximately 100,000,000 lb. of copper annually and require 4,000 hp. to operate. The president is Nathan T. Brenner, who is also head of the American Insulated Wire & Cable Co.

TRADE CATALOGS

The Ingersoll-Rand Co., 11 Broadway, New York, has just issued a new 36-page bulletin describing their "Imperial" type XPV steam-driven air compressors. This type of compressor is built in a number of different types and sizes. Standard two-stage machines for 100 lb. discharge pressure, range from 246 to 4,150 cu.ft. per minute piston displacement. Single-stage compressors are built for furnishing air up to 50 lb. discharge pressure. This compressor was first offered in 1912 and there is now over 135,000 hp. in use.

The Coxe traveling grate stoker is described in an eight-page pamphlet just issued by Combustion Engineering Corporation, Combustion Engineering Bldg., Broad St., New York. Particular reference is made to its performance in burning small-sized anthracite coal and coke breeze.